STEPHENS ENGINEERING ASSOCIATES INC.

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HF SINGLE SIDEBAND

RADIOTELEPHONE

MODEL SEA 112

INSTRUCTION AND MAINTENANCE MANUAL

STEPHENS ENGINEERING ASSOCIATES, INC.

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1. GENERAL INFORMATION

1.1 DESCRIPTION

The SEA 112 is a compact, all solid-state, 150 Watts PEP, HF SSB transceiver for the marine and HF radio service.

The set covers the frequency range from 2 to 13 MHz with no frequency restrictions on receive or transmit. The channel capacity is 40 semi-duplex or 80 simplex or any combination. The upper sideband is transmitted. The channel frequencies are controlled by a precision crystal housed in a proportionally controlled crystal oven. The transceiver works off a 13 V DC negative ground system. The RF impedance is 50 OHms and is compatible with all SEA antenna couplers or trap antennas.

1.2 EQUIPMENT FURNISHED

1.2.1 SEA 112 radiotelephone

1.2.2 Microphone and microphone clip

1.2.3 Mounting bracket

1.2.4 6-pin power connector

1.2.5 Instruction and Maintenance Manual

1.2.6 Frequency allocation booklet

1.3 MECHANICAL INFORMATION

Size	40.6cm W x 14cm H x 35.6cm D 16" W x 5.5" H x 14" D
Weight	8.2 kgs or 18 lbs
Mounting Positions	Any orientation

1.4 ELECTRICAL SPECIFICATION

1.4.1 General

Type Acceptance	FCC Parts 81, 83, 89, 91
Frequency Range	2-13 MHz
Circuitry	Dual Conversion (21.4 MHz, 455 KHz)

Channel Capacity	80 simplex or 40 semi-duplex via pre-programmed memory
Front Panel Controls	Volume ON/OFF, Squelch/RF Gain, A/B Channel, Channel Selector, Band Selector, A3A/A3J
Operating Temperature Range	-30 degrees to +60 degrees C
Frequency Stability	20 Hz
Operating Modes	A3A, (SSB -16 dB carrier) A3J, (SSB -40 dB carrier)
Primary Voltage	13.6 DC + or - 15%, negative ground
Current Drain	
Receive Standby	2A
Receive Full Audio	2.5A
Transmit Average Voice	11A
Transmit Two Tone	19A
RF Impedance	50 OHms

1.4.2 TRANSMITTER

Power Output (into 50 OHms)	A3A, A3J, 150 Watts PEP
Intermodulation	-32 dB below PEP
Spurious Emissions	-64 dB below PEP
Carrier Suppression	-46 dB below PEP
Undesired Sideband Suppression	-60 dB below PEP
Audio Response	300 Hz to 2400 Hz, + or - 3 dB

1.4.3 RECEIVER

Sensitivity: SSB	1 microvolt for 12 dB SINAD, 500 mV audio
Selectivity: SSB	300 Hz to 2400 Hz
AGC	Audio output varies less than 10 dB for signals between 10 microvolt and 100 mV, fast attack, slow release

Intermodulation	At least -80 dB
Spurious Responses (incl. image)	At least -60 dB
Noise Limiter	Diodes
Audio Power	4 watts at less than 10% distortion

2. OPERATION

2.1 WARM-UP CAUTION

Do not attempt to transmit until the radiotelephone is warmed up for at least 3 minutes. Transmitting before the 3 minute warm-up period has elapsed can cause a violation of FCC regulations.

2.2 FCC REQUIREMENTS

Before a SSB radiotelphone can be licensed, a VHF radio set has to be installed. A valid ship station license, in addition to an operators license, is required to operate a radiotelephone. FCC forms #502 and #753A can be obtained from a SEA dealer or direct from the factory. Aliens can obtain form #755 from the nearest FCC office.

2.3 OPERATING PRACTICES, FCC PARTS 81 and 83

"How to Correctly Operate Your Radiotelephone Set" is a booklet available from the Radio Technical Commission for Marine Service (RTCM), P.O. Box 19087, Washington, D.C. 20036 and is highly recommended reading material.

2.4 FRONT PANEL CONTROLS AND INDICATORS

Figure 1 illustrates the front panel of the SEA 112. The function of these controls are as follows:

- Volume/Off: This control adjusts the loudness of the receiver and turns the set on and off. To turn the set ON, turn the Volume/Off control knob CLOCKWISE until a click is heard. Turning the control knob further clockwise will increase the receiver volume level.

- Squelch/RF Gain: This control turns on the squelch in the push-in position. With the control in the pull-out mode, the RF gain level can be set.

  NOTE: At any one time only one of these functions can be exercised.

- A/B Switch: This control is used to obtain two frequencies on one position of the CHANNEL switch. It is only operational when the channel is internally programmed for simplex operation.
- Channel Selector: Used to select the desired operating frequency within a given BAND.
- Band Switch: Used to select which of the 12 available frequency BANDS is to be used.
- A3A/A3J: Used in duplex channels to remove (when desired) a -16 dB reference frequency.
- Transmit Indicator Lamp: Indicates when power is applied to transmitter circuitry.
- Unlock Indicator Lamp: Indicates that the transmitter is disabled, either through the program in memory or failure of either of the two phase detectors to lock.

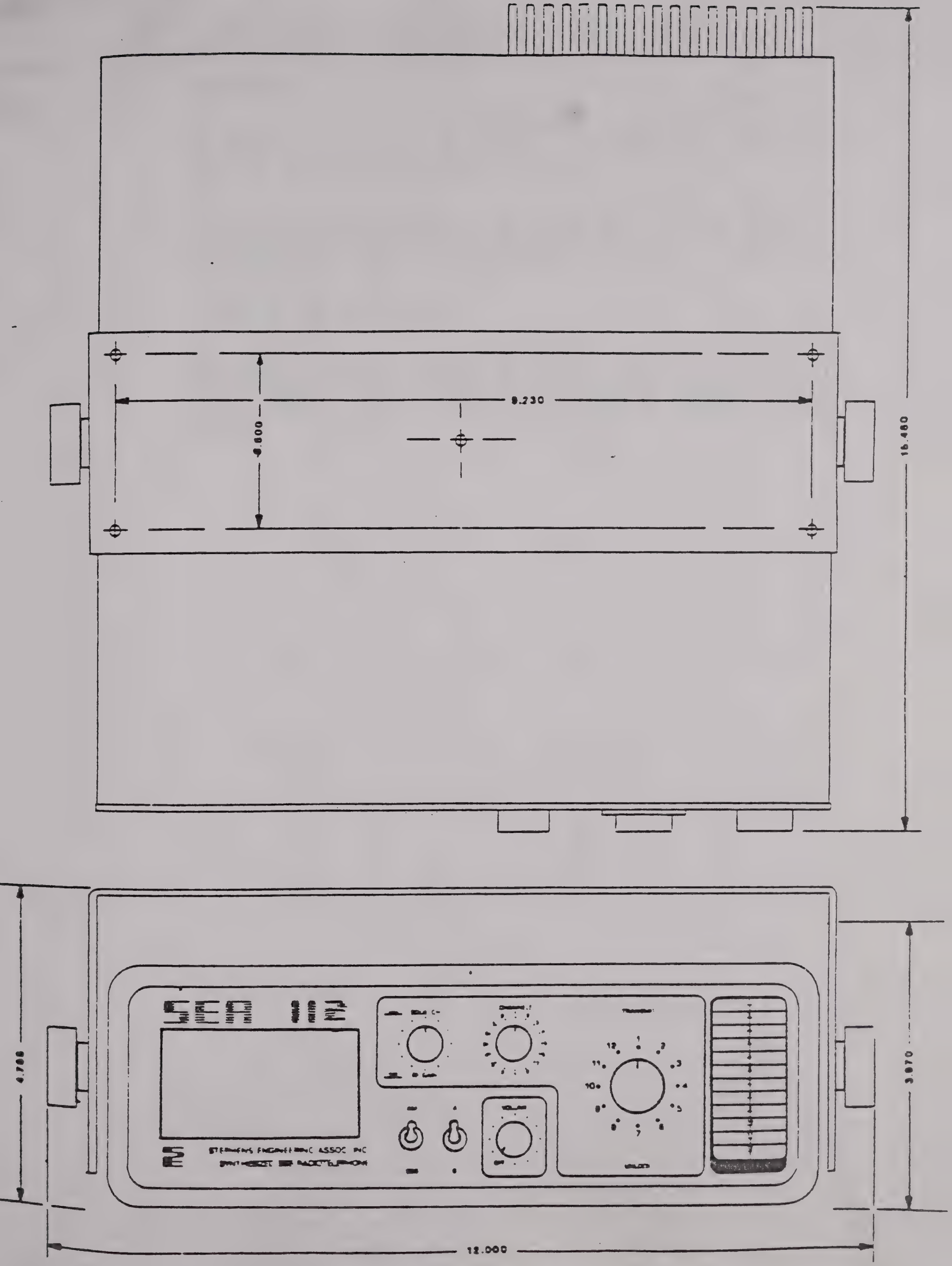


Fig. 1 SEA 112 Front Panel

2.5 PROPAGATION

HF signals do propagate far beyond the horizon. MF frequencies (2-3 MHz) are generally usable within 300 miles depending on the daytime, atmospheric and man-made noise.

The High-Seas frequencies (4, 6, 8, and 12 MHz bands) allow communications over thousands of miles, again subject to the above mentioned limitations. Interference tends to be more of a problem than on VHF.

2.6 OPERATING THE TRANSMITTER

The operation of the transmitter is fairly straight forward. Do not shout into the microphone as it will decrease intelligibility. Acknowledgement of a message cannot be done by keying the microphone since no signal is transmitted until the operator actually speaks.

3. PROGRAMMING

3.1 FREQUENCY AND MODE SELECTION

The SEA 112 has the capability to contain (in pre-programmed memory) up to 80 simplex or 40 duplex frequencies, or any combination thereof.

This capacity allows the use of pre-programmed memory sets, consisting of three programmed ROMs. Such sets contain mode and frequency information for all SEA 112 channels and have been selected for general utility, based on the various requirements of several different types of vessels. A booklet listing the frequencies and operating modes contained in each ROM set is provided with this equipment.

Additional ROM sets may be obtained by contacting the factory.

Special ROM sets may be custom programmed to meet an individual requirement. For such sets, a one-time-only set up fee is required. Contact the factory for details.

3.2 BANDWIDTH LIMITATIONS

The only limitations imposed by the SEA 112 is that A/B frequencies must be within the same low pass filter range. Since the filters are automatically selected by the BAND switch, the likelihood of a forbidden overlap is minimal. The 3 ranges employed are: 2-3.4 MHz, 4-6.9 MHz, and 8-13 MHz. Very likely, the antenna system used will dictate the maximum allowable frequency separation.

3.3 CAUTION, FREQUENCY TOLERANCE

Under FCC Part 83 (ship stations), the maximum frequency tolerance is + or - 50 Hz, while shore stations (Part 81) are allowed only + or - 20 Hz. To achieve this accuracy a frequency counter with a long term accuracy of 1-3 Hz should be used.

All work effecting the transmitter performance must be carried out by or under the supervision of a person holding at least a second class FCC radiotelephone license.

3.4 SETTING THE CRYSTAL FREQUENCIES

3.4.1 THE MASTER CLOCK

Either of two methods may be used to adjust the master clock:

1. Hook up a frequency counter to TP1 of the counter board (Pin 8, A1). Signal amplitude is approximately 10 Vp-p. Adjust C4 for 9100 KHz + or - Zero Hz.

2. Select the highest desired transmitter frequency. (Such as 12,433 KHz.) With the transmitter output connected to an appropriate dummy load, adjust C4 until the measured re-inserted carrier frequency is the same as the indicated frequency.

Allow the SEA 112 a minimum of 20 minutes warm-up prior to adjustment of the master clock.

3.4.2 THE CARRIER

The 455 KHz carrier is derived from the master clock. No independent frequency adjustment is required.

3.5 OUTPUT TO ANTENNA COUPLER

BAND switch wafer #5 is used to preset the various SEA antenna couplers through connector J1. A 13.6 V voltage buss and DC ground is also provided to the antenna coupler through J1. See schematic diagrams and coupler instruction manual for details.

4. INSTALLATION

4.1 MOUNTING THE SEA 112

The SEA 112 is compact enough to allow great flexibility in location, even on smaller vessels. Several options for mounting are available. The mounting bracket fits underneath or on top of the transceiver for bulkhead, overhead, or shelf locations. Fig. 1 shows the outline dimensions of the SEA 112 and bracket mount. The bracket can be used as a template to locate the mounting holes. When choosing the location for the radio set, take care to avoid areas directly over a heater or lacking adequate ventilation. In particular, avoid blocking air flow around the heatsink fins on the rear panel of the SEA 112.

4.2 A TYPICAL INSTALLATION

Figure 2 shows a typical installation consisting of three parts: (1) the radio equipment; (2) interconnecting cables; and (3) the antenna system. Any radio communications system operating in the MH-HF spectrum must have an adequate ground connection, otherwise the overall efficiency of the radio installation is degraded. In extreme cases, it may be impossible to properly load the radio-telephone into the antenna.

The 50 OHm output impedance of the SEA 112 makes it necessary to employ antennas of the trapped or externally matched type. The use of the SEA 1060, or 1010 antenna coupler in conjunction with a whip antenna allows an efficient installation which will cover both the MF and HF bands. These antenna couplers were designed specifically for marine applications and will easily interface with the SEA 112 radio set.

On wooden or fiberglass boats, the use of a copper ground plate or the keel on a sailboat perform adequately. The ground system MUST be joined to the antenna coupler with a heavy copper strap.

4.3 REAR PANEL CONNECTIONS AND FUSES

4.3.1 THE POWER CONNECTOR

Pin 1 and 2: Parallel, ground, minus side of battery
Pin 3 and 4: Parallel, positive side of battery
Pin 5 and 6: Remote ON/OFF, isolated from set, activated by VOLUME pot

For less than 10 feet, #8 cable can be used; over 10 feet, use #6; and more than 20 feet should not be used. Use a direct run to the power source. If a power supply is used, place it as close as practical to the radio set.

4.3.2 THE ANTENNA COUPLER CONNECTION J-2

The antenna coupler is controlled through this connector. Use Carlyle #262216 or equivalent. If no antenna coupler is used, be sure to short Pin 14 and 15 together since the PTT circuit is normally interlocked through the antenna coupler.

4.3.3 THE RF CONNECTORS

Two UHF connectors are provided. With one antenna system, the connector marked "antenna" is used. The connector marked "spare" would be used in a system using two antennas. The most often used cable is of the RG-8A/U and RG-58C/U type.

4.3.4 THE TERMINAL STRIP

The terminal strip is provided to install an extension (simple remote), an external loudspeaker, or a handset.

Terminal function:

AF - Output of the audio amplifier, AC coupled. Speaker impedance to be used is 3 OHms or more.

SPKR - Internal speaker input. A jumper to AF is needed to operate the internal speaker.

MIC - Input for a microphone in parallel with supplied palm microphone which may need to be disconnected.

PTT - Input to the transmitter keying circuit. By applying ground potential, the PTT relay is activated. Interlocked through Pin 14 and 15 of the antenna control connector.

GND - Access to the negative side (ground) of the primary supply.

4.3.5 FUSING

Two fuses are provided:

A main fuse, 25A slo-blo, protecting mainly the RF power amplifier Bussman No. MDR25.

A 5A fuse protecting the rest of the set. Bussman No. AGC-5, 250V.

4.3.6 THE GROUND CONNECTION

A bolt and nut are provided to hook up the SEA 112 to the engine block, and keel, or similar ground.

5. THEORY OF OPERATION

5.1 GENERAL

The SEA 112 is a double conversion HF SSB transceiver. Certain circuits perform the same function in receive and transmit (bilateral design). The first intermediate frequency (IF) is 21.4 MHz and permits the use of a low pass filter to provide excellent image, spurious and harmonic rejection. A broad band design approach results in a minimum of tuned circuits. The second IF of 455 KHz allows the use of a mechanical filter for sideband selection.

The SEA 112 also employs a unique UP-DOWN conversion technique along with a dual loop phase locked oscillator system to allow complete frequency coverage without the addition of channel control crystals. Since the high frequency oscillators are all either enclosed in an error cancellation loop, or phase locked to a high stability reference oscillator, the frequency stability is strictly a function of the 9.100 MHz clock.

5.2 THE RECEIVER

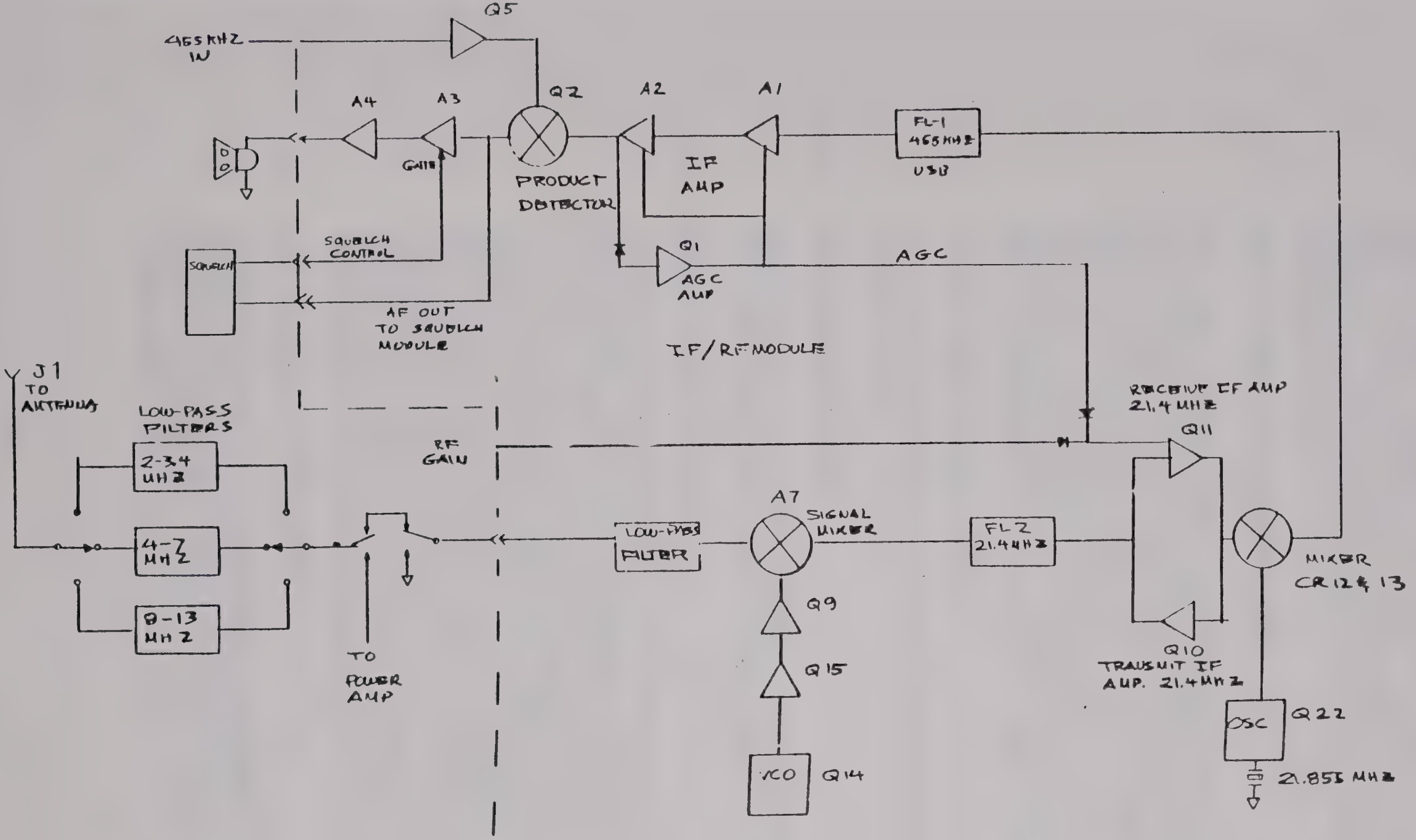
5.2.1 BLOCK DIAGRAM

Figure 4 shows the block diagram of the receive mode.

The receive RF signal is routed from the antenna jack, J-1, through a set of switchable low pass filters to remove spurious responses. The signal then passes through the T/R relay, K1, and the pin diode, to the receive RF jack J-101 on the RF/IF board (A100). The signal passes through another 13 MHz low pass filter to a double balanced mixer, A107.

The output from a 23-35 MHz VCO is injected into A107 along with the received signal, resulting in an IF signal of 21.4 MHz. This first IF signal is passed through a 4 pole crystal filter of approximately 20 KHz bandwidth. This provides a comparatively narrow bandwidth "window" which protects the following circuitry from intermodulation problems. The resultant IF signal is then amplified by transistor Q111. The amplified, filtered signal is then applied to a single balanced mixer along with the output of the 21.855 MHz crystal oscillator and converted to the second IF frequency of 455 KHz.

The upper sideband is selected by filter FL-1. The 455 KHz IF strip consists of A101 and A102 I.C. amplifiers. At the output of A102 is a noise limiter, a fast attack, slow release AGC and the product detector. An electronic attenuator, A103 serves as a squelch gate and audio pre-amplifier for the 4 watt audio power amplifier, A104.



RECEIVE BLOCK DIAGRAM SBA 112

FIG 4

5.2.2 RECEIVE RF CIRCUITRY AND FIRST MIXER

An incoming signal passes through a switch selected low pass filter (A400 assembly), through the T/R relay, through the the pin diode, to the RF/IF board (A100). Another low pass filter attenuates the spurious responses still further. A double balanced mixer, A107 assures minimal cross modulation and intermodulation.

5.2.3 THE 21.4 MHz IF AND SECOND MIXER

The output of mixer A107 is passed through FL102, a four pole monolythic crystal filter with a bandpass of approximately 20 KHz. The IF signal is then amplified by Q111 and passes on to a balanced mixer consisting of hot carrier diodes CR112 and CR113. This is a single balanced mixer, since narrow bandwidth filters are present at both input and output. Q111 and Q110 (the transmit and receive IF amplifiers, respectively) are switched by CR111 and CR110 through the +9V Tx and +9V Rx buss voltages.

5.2.4 THE 455 KHz IF FILTER (SSB)

One filter is provided, for SSB, a 455 KHz mechanical USB filter (FL101).

5.2.5 THE RECEIVE IF STRIP

The receive IF amplifier consists of two integrated circuits, A101 and A102, with a total voltage gain in excess of 100 dB.

5.2.6 NOISE LIMITER AND AGC

A noise limiter network is connected across the output IF transformer T101. The network consists of capacitors C113 and C114, resistors R106 and R107, and diodes CR101 and CR102. These components limit the level of noise pulses across the primary winding of T101, preventing AGC "pump up" on impulse noise. The output of the IF amplifier is coupled through a capacitor to the AGC detector diode CR103, which conducts to charge C115 to a voltage level equal to the peak voltage on T101. The release time constant is a function of C115 and R109 and is set to approximately one second. Q101, and "N" channel JFET, amplifies and inverts this peak voltage at the AGC buss to about +3.5 V DC. An increasing signal level increases the AGC buss voltage.

5.2.7 THE ELECTRONIC ATTENUATOR

A104 functions as an electronic attenuator. When a positive signal from the squelch module is applied through CR104, the AF signal is attenuated 40 dB. When the signal goes negative (unsquelched) the signal is amplified 10 dB.

5.3.2 MICROPHONE PREAMPLIFIER

T103, an input transformer, matches a low impedance carbon or dynamic microphone to the higher input impedance of the amplifier formed by Q104 and Q103. R131 provides DC current in the case of the carbon microphone, while C145 serves to minimize line noise, etc. which might be present on the +9 V DC buss. Potentiometer R128 sets the appropriate modulation level.

NOTE: Make the following modification for dynamic microphones.

Remove	R130	620 Ohms
Remove	R131	470 Ohms
Short Out	R129	100 Ohms

5.3.3 TRANSMIT BALANCED MODULATOR

Audio from Q103 and the carrier (455 KHz) from Q105 (5.2.8) are combined in A106, an I.C. balanced modulator. This device needs no external balance control to provide at least 40 dB carrier suppression. The output from A106 is a double sideband suppressed carrier signal at a frequency of 455 KHz.

5.3.4 TRANSMIT IF AMPLIFIER

A105 functions as a low gain IF amplifier/attenuator controlled by an ALC feedback voltage. The ALC control voltage is derived from circuitry in the final amplifier module. This feedback insures that the drive level to the final amplifier does not become excessive and cause distortion.

5.3.5 FIRST TRANSMIT MIXER AND SECOND IF

The output of A105 is applied to FL101, a mechanical SSB filter. This filter removes the unwanted lower sideband and further attenuates the carrier signal. The resultant upper sideband (USB) signal is connected through transformer T108 to the first transmit mixer consisting of CR112 and CR113. This matched pair of hot carrier diodes is driven by the 21.855 MHz oscillator and converts the USB 455 KHz signal to a LSB signal at the second IF frequency of 21.4 MHz.

This 21.4 MHz signal is then amplified by the transmit 21.4 MHz IF amplifier, Q110. This device, together with Q111, form a bilateral IF amplifier. Each of the two devices is activated by either the +9 V Rx or +9 V Tx buss. Diodes CR110 and CR111 help isolate the unused amplifier and prevent feedback problems.

5.3.6 SECOND TRANSMIT MIXER AND BUFFER AMPLIFIER

The output of the transmit IF amplifier is passed through the 21.4 MHz crystal filter and then applied to the double balanced signal mixer, A107, along with a signal from the first conversion oscillator. This converts the 21.4 MHz signal to the desired output frequency and again inverts the signal, forming an USB

emission, as desired. This frequency is filtered by the 13 MHz low pass filter and amplified by Q106, Q107 and Q108 to approximately 0.65 V rms. R145 establishes the main transmitter gain level.

5.3.7 THE RF POWER AMPLIFIER (A3)

A coaxial cable conducts the TX-RF of the A1 board to the input (J301) of the A3 board, the RF power amplifier. Q301 and Q302 is transformer coupled to the driver transistor Q302 through a toroidal wideband transformer, T302. The use of heavy negative feedback in both Q301 and Q302 provides a flat frequency response and excellent linearity. Coupling between the driver stage Q302 and the push-pull final amplifier Q303, Q304, is accomplished through T303. This transformer and the output transformer T304 are of unique design. They make use of ferrite loaded tubular low impedance "windings" which have the higher impedance windings threaded through the tubular members. This technique provides a transformer with excellent balance, frequency response, and power handling capability. The push-pull power output stage in the SEA 112 employs a matched pair of high power RF devices biased into Class B operation for maximum efficiency and low distortion. This raises the power level to 150 watts PEP (Peak Envelope Power). The signal is routed through channel switch contacts to an appropriate output filter.

5.3.8 THE BIASING OF Q303 AND Q304

Biasing for the pair is provided from the Zener diode CR302 (10 V) through emitter follower Q307, a power transistor. A similar power transistor, Q305, is bonded to the P.A. heatsink, thus providing temperature tracking for the output transistor bias line. Idling current for the output stage, Q303 and Q304, is adjusted to about 50 ma under no modulation conditions.

CAUTION!! When adjusting Q303, Q304 idling current, insure that the coaxial input cable is disconnected from J301 before inserting meter in the heavy +13.6 V DC lines. This is a high current circuit and a sensitive meter may be instantly destroyed if proper care is not taken.

5.3.9 THE ALC CIRCUIT

A tertiary winding on T305 provides RF for the ALC feedback. CR303 and CR304 rectify the RF voltage and the resulting DC potential appears across R325 through an emitter follower, Q306. A portion of this voltage is applied to A105, an I.C. with a dynamic range in excess of 50 dB. This constitutes an effective means of controlling the maximum peak power output of the transmitter.

5.4 THE PHASE LOCKED LOCAL OSCILLATOR SYSTEM

5.4.1 BLOCK DIAGRAM

Figure 6 shows the block diagram of the phase locked local oscillator system of the SEA 112, including the UP-DOWN converter.

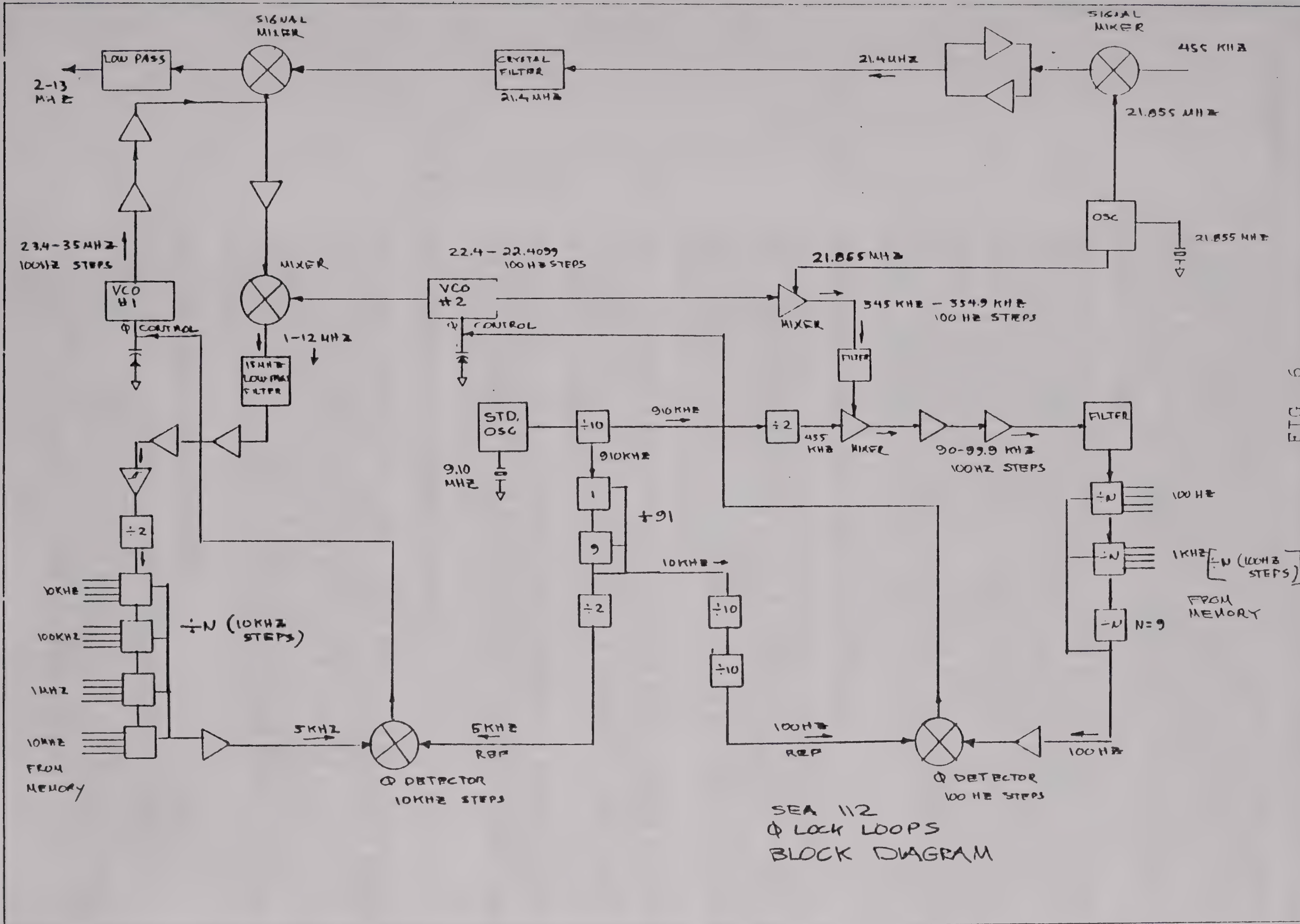
A two loop system is employed in the SEA 112, consisting of the high frequency loop, operating with a 5 KHz reference frequency and the low frequency loop which operates with a 100 Hz reference. The combination of two loops provides 100 Hz resolving power over the high frequency spectrum, along with optimum loop switching and settling times.

The two phase locked oscillators are combined with a unique UP-DOWN conversion scheme which provides automatic error cancellation of the internal hetrodyne oscillator drift, along with a 21.4 MHz first IF frequency.

The high frequency loop starts with the VHF VCO (voltage controlled oscillator), Q114. This oscillator operates over the frequency range of 23-35 MHz and is varactor tuned by an output voltage from phase detector (2A7) on the counter board A2. The VCO signal is buffered by Q115 and then applied through amplifier Q109 to the signal mixer, A107. Simultaneously a sample of the VCO output is buffered through Q116 and applied to mixer A108, the synthesizer down converter, along with a 22.4 MHz signal from 100 Hz VCXO Q120 and amplifier Q119. The down converted VCO signal, from 1-12 MHz is passed through a low pass filter to buffer amplifier Q117 and Q118. The amplified, filtered down converted VCO signal is then transmitted through coaxial cable to the counter board where it is applied to 2A13. The resultant square wave RF signal then goes to the high frequency programmable divide-by-N counter circuit. The function of this circuit is to count the synthesizer down converted output frequency down to the high frequency loop reference frequency of 5.00 KHz. This 5 KHz pulse train is sent to phase detector 2A7 along with a stable 5 KHz reference frequency derived from the master clock. Any PHASE difference between the two signals is detected, converted to an appropriate error voltage, and fed back to the VCO through appropriate loop filters.

The low frequency loop starts with the VCXO (100 Hz steps), Q120. This oscillator operates over the frequency range of 22,400-22,409.9 KHz in 100 Hz increments and is varactor tuned by an output voltage from phase detector 2A8.

The 21.855 MHz signal from Q122 is applied to the second signal mixer, CR112 and CR113. Simultaneously, a sample of the signal is applied to the transistor mixer Q121. This mixer is also provided with an input from the VCXO Q120. The down converted VCXO signal is routed from transformer, T113, at a frequency of approximately 545 KHz, to the counter board. On the counter board the signal is again mixed, this time with a 455 KHz signal from the master clock.



SEA 112
Φ LOCK LOOPS
BLOCK DIAGRAM

FIG 6

The difference frequency at approximately 90 KHz is then shaped by Schmitt Trigger, 2A13, and applied to the input of the low frequency programmable divide-by-N counter, consisting of 2A14, 2A15 and 2A16. In this divider, the 90 KHz frequency is divided to 100 Hz and compared to stable 100 Hz master clock. This voltage is, after appropriate filtering, fed back as the correction voltage.

Examination of the block diagram, along with the above explanations, will reveal that oscillator Q122 is enclosed in an error cancellation circuit. That is, any frequency shift in this oscillator will be cancelled and will cause no corresponding frequency shift in the SEA 112 OUTPUT frequency. This is true because the 21.855 MHz signal from Q122 is used to simultaneously down convert BOTH VCO signals. Thus, a change in the 21.855 MHz signal frequency will not result in a net VCO DIFFERENCE frequency change. Thus, any 21.855 MHz oscillator drift will NOT affect the SIGNAL frequency.

5.4.2 THE REFERENCE CLOCK OSCILLATOR AND PRESCALER

The master clock oscillator operates at a frequency of 9.1 MHz. This frequency allows the use of a compact, high stability crystal which is enclosed within a precision proportional oven. This oven maintains the crystal at a temperature of 75°C over the environmental range of the equipment. Warm up time for the master clock is less than 3 minutes.

The oscillator circuit makes use of CMOS gates, biased for oscillator service. Two extra gates are cascaded and used for buffering. The oscillator output is a square wave suitable for driving the following prescaler circuit.

The prescaler uses a 74LS90 which operates as a decade divider. The output at 910 KHz is routed both to the second prescaler stage and to the REFERENCE DIVIDER CHAIN. The second prescaler output is at 455 KHz and is used in mixer 2Q6 (5.4.10).

5.4.3 THE DIVIDE-BY-91 REFERENCE COUNTER

Integrated circuits 2A4 and 2A5 are connected as a preprogrammed divide-by-91 counter. Each counter stage consists of a programmable down counter with the preset number entered in BCD format. Two such stages are cascaded to allow a count of 91. Thus, the output of the counter is a pulse train at a frequency of 10.0 KHz. This pulse train is sent to the following 100 Hz reference counter and is also used as a trigger for the 5 KHz reference divider.

5.4.4 THE 100 HERTZ REFERENCE COUNTER

Integrated circuit 2A6 is a dual decade counter, cascaded to provide a divide-by-100 counter. Since the counter input is the 10.0 KHz reference pulse, the output is at 100 Hz, with master clock stability. The output pulse train is a symmetrical square wave which is used as the phase reference signal for the low frequency phase lock loop.

5.4.5 THE 5 KHz REFERENCE DIVIDER

Integrated circuit 2A3 is a dual "D" flip-flop. Half is used to scale the 910 KHz output of 2A2 to 455 KHz. This signal is used in the RF board as the carrier signal and is also used in the low frequency down converter, 2Q6. The second half of 2A3 is used to scale the 10 KHz output from the divide-by-91 counter down to 5 KHz. The 5 KHz symmetrical square wave is used as the phase reference signal for the high frequency phase lock loop.

5.4.6 THE HIGH FREQUENCY PROGRAMMABLE DIVIDE-BY-N COUNTER

Integrated circuits 2A10, 11, 12, 13, 17, 18, 19 and 2A20 form the high frequency programmable counter. 2A13 is a dual Schmitt Trigger, one half of which acts as a pulse squaring circuit for the 1.0 to 12.0 MHz input signal from the RF board. 2A17, 18, 19, and 20 are high speed UP-DOWN counters, here used in the DOWN count mode. In operation, a preset number, "N" is loaded into the counter train which then counts down to zero. At this time an output pulse is generated and the preset "N" is again loaded into the counter train. One half of 2A12 is used as a divide-by-2 prescaler ahead of the counter train. The second half of 2A12 is used along with 2A10 and 2A11, as an "early decoder." The use of early decoding eliminates the one count offset typical in such counters without decoding and also insures that the divide-by-N will function well above the frequency range required in this equipment.

5.4.7 THE HIGH FREQUENCY PHASE DETECTOR/LOOP FILTER

Integrated circuit 2A7 is a CMOS phase detector circuit, whose output voltage is proportional to the phase difference between a 5.0 KHz square wave from the master clock and a 5.0 KHz pulse train from the high frequency programmable counter. The error voltage is filtered through a multi-stage R/L/C filter, located between the detector output pin and the varactors located in the VHF VCO on the RF board.

5.4.8 THE VCO AND FIRST SYNTHESIZER DOWN CONVERTER

The VCO (voltage controlled oscillator) serves as the first conversion oscillator for the UP-DOWN converter, and operates over the frequency range of 23-35 MHz (corresponding to an operating frequency range of 2-13 MHz).

The oscillator circuit is a MOSFET Pierce type, with a high Q toroid inductor as the frequency determining component. Varactor diodes CR119 and CR120 are hyperabrupt junction devices which provide a wide, linear tuning range with minimum oscillator loading effects. A high speed diode, CR118, provides leveling bias to the gate #1 circuit of the MOSFET. Range adjust capacitor C129, allows the center frequency of the oscillator circuit to be adjusted for optimum loop performance.

Transistors Q115, Q116, and Q109 provide buffering for the VCO signal as required.

Since the high frequency programmable counter uses TTL logic which can count to only about 15 MHz, it is necessary to convert the VCO signal to the HF spectrum. This is accomplished in double balanced mixer A108. In this mixer, the VCO signal is mixed with a signal from the approx. 22.4 MHz oscillator. The resultant 1.0-12.0 MHz signal is selected by a low pass filter and amplified by Q117 and Q118 before being sent through coaxial cable to the logic circuitry on the counter board.

5.4.9 THE VCXO AND SECOND SYNTHESIZER DOWN CONVERTER

The VCXO (voltage controlled crystal oscillator) serves as the second conversion oscillator for the UP-DOWN converter and operates over the frequency range of 22.4-22.4099 MHz.

The oscillator circuit is a transistor Pierce type, with an inductor in series with the crystal allowing the oscillator to be voltage tuned over the required frequency range.

Mixer transistor Q121 accepts inputs from both the VCXO and the 21.855 MHz oscillator and provides a down converted output from 545-554.9 KHz. The use of the 21.855 MHz oscillator as one input closes the error cancellation loop (5.4.1) as described in the THEORY OF OPERATION.

5.4.10 THE SECOND CONVERSION MIXER

The low frequency programmable counter uses CMOS integrated circuits and is thus somewhat limited in maximum frequency.

For this reason, the 545 KHz signal from the VCXO down converter is again converted to a lower frequency in mixer 2Q6. The mixer is provided with a stable 455.0 KHz input from the master clock and the resultant output frequency band of 90 to 99.9 KHz is well within the range of the low frequency programmable counter, even when it is operated at TTL voltage levels. Transistors 2Q7 and 2Q8 form a buffer amplifier/filter to increase the 90 KHz output from 2Q6 to a sufficient level to operate the Schmitt Trigger, 2A13.

5.4.11 THE LOW FREQUENCY PROGRAMMABLE DIVIDE-BY-N COUNTER

CMOS integrated circuits 2A14, 2A15, and 2A16 form the low frequency programmable counter. These are programmable down counters cascaded to allow counts of up to 999. In this circuit, 2A14 is programmed to count by 9, thus restricting the counter range from 900 to 999. Counter chips 2A15 and 2A16 are programmed from stored memory. The output of the low frequency programmable counter is a 100 Hz pulse train which is applied, along with a 100 Hz reference from the master clock, to phase detector 2A8.

5.4.12 THE LOW FREQUENCY PHASE DETECTOR/LOOP FILTER

Integrated circuit 2A8 is a CMOS phase detector circuit, whose output voltage is proportional to the phase difference between the 100 Hz pulse train derived from the low frequency programmable counter (and thus from the VCXO) and a 100 Hz pulse train from the master clock. The error voltage is filtered by a second order R/C loop filter on the A2 board. The filtered error voltage is then used to control the frequency of the VCXO on the RF board.

5.4.13 THE IF OFFSET AND PROGRAM

The UP-DOWN converter technique used in the SEA 112 makes use of a 21.4 MHz first IF frequency (5.4.1). However, the use of "down conversion" technique for the VCO and VCXO signals results in a "phantom IF" frequency of 1000 KHz. That is, if the VCO signal is examined, it will be necessary to operate the VCO at a frequency which results in a "down-converted" VCO frequency 1000 KHz lower than the desired frequency. For example, at 10.000 KHz the VCO operates at a frequency of 31.4 MHz which will, after conversion, result in a down converted VCO frequency of 10.000 KHz. Note that this is 1.000 MHz lower than the desired frequency of 10.000 MHz.

5.5 THE CHANNEL FREQUENCY MEMORY AND DISPLAY

5.5.1 THE BLOCK DIAGRAM

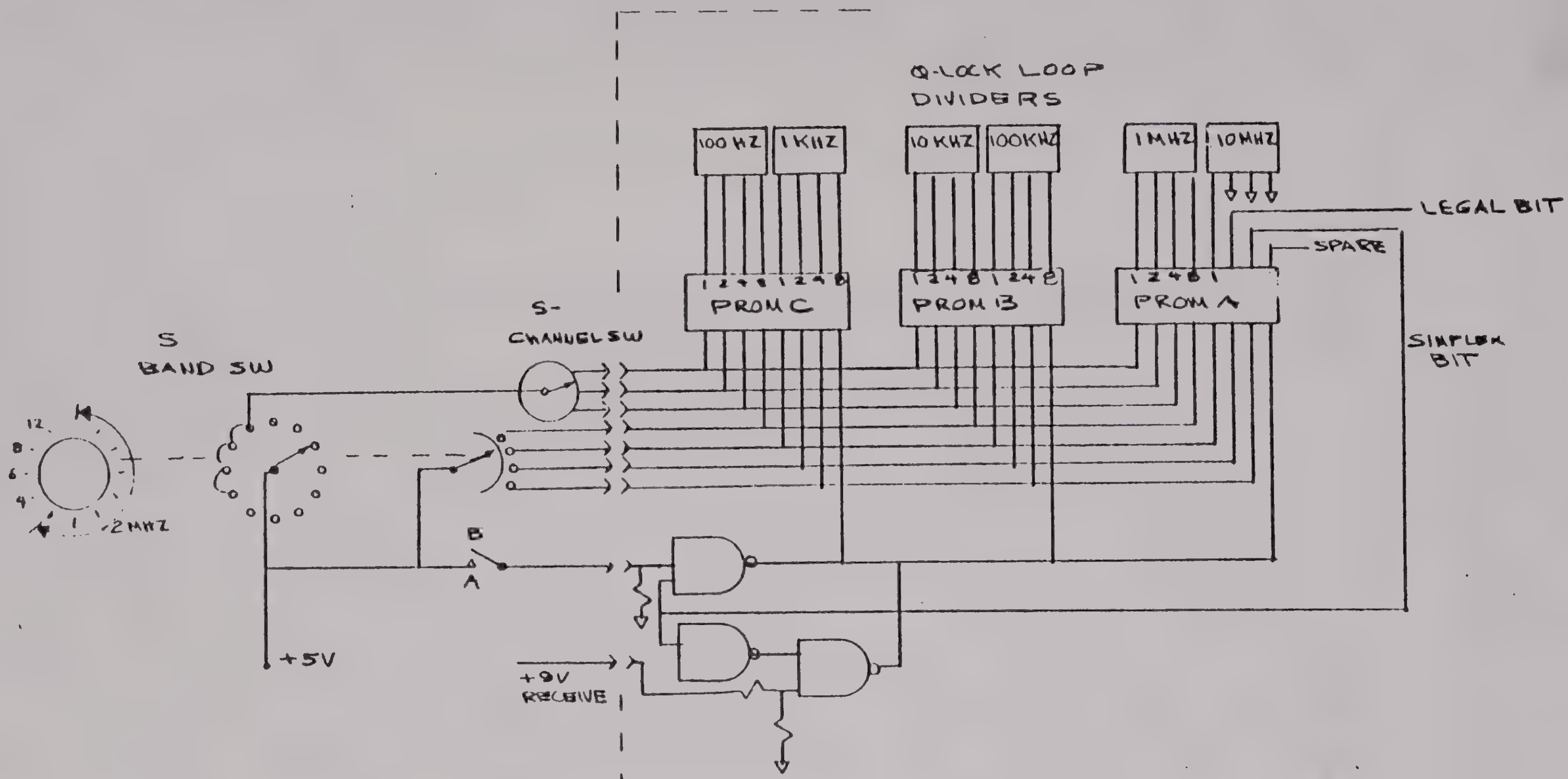
Figure 7 shows the block diagram of the memory and display system.

As mentioned in the phase lock section (5.4), a specific frequency is generated by entering a program number "N" into the two divide-by-N counters in the phase locked loops.

In order to enter a program number "N", a 6-digit word is called from the frequency memory and programming circuitry. Additional information regarding operating mode is also stored in the frequency memory along with the frequency data. The optional frequency display senses the output of the frequency memory and displays this information on the front panel.

5.5.2 THE PROGRAMMABLE READ ONLY MEMORY

Figures 7 and 8 reveal that the actual storage mechanism in the SEA 112 frequency memory is an array of three PROMs. Each PROM has eight output lines and a storage capacity of 2048 bits. 20 of 24 available output lines from the PROM array are arranged as the five least significant digits contained in the six digit "word" required by the counter board. The remaining four lines are used to store additional information regarding operating mode.



SEA 112
MEMORY ADDRESS
BLOCK DIAGRAM

FIG 7

BANDSWITCH ADDRESS CODE SEA 112

NO	BAND RANGE	H	G	F	D
1	2.0	0	0	0	1
2		0	0	1	1
3		0	1	1	1
4	TO	1	1	1	0
5		1	1	0	1
6		1	0	1	1
7		0	1	1	0
8	3.5	1	1	0	0
9	4.0	1	0	0	1
10	6.0	0	0	1	0
11	8.0	0	1	0	0
12	12.0	1	0	0	0
	Weight	128	64	32	8

FIGURE 8

5.6 MEMORY ADDRESSING

5.6.1 THE BLOCK DIAGRAM

Figure 7 shows the block diagram of the memory addressing system used in the SEA 112.

5.6.2 THE BAND SWITCH

The SEA 112 has 12 frequency BANDS, selected by the front panel band switch, S1.

S1 is a multi-wafer switch which selects the required low pass filter and also controls four of the eight PROM address input lines. Note that eight input lines indicate that an actual memory capacity of 256 words is available.

The memory address band switch wager generates a unique four wire code which accesses lines 4, 6, 7, and 8 of the PROM address inputs. Thus, for each of the 12 switch positions, 12 separate lines of memory are available. See Page 28 for an address "map" displaying the band switch access code.

5.6.3 THE CHANNEL SELECTOR SWITCH

Each of the 12 BANDS in the SEA 112 may be further divided into 8 CHANNELS, through the use of switch S2. This swith is "octal" coded and controls PROM address inputs 1, 2, and 3. The channel switch is deactivated in the first eight bands and an alternate program is entered from the program/interface PC board (see 5.6.5).

5.6.4 THE DUPLEX - A/B CONTROL BUSS

Since DUPLEX operation requires that each CHANNEL position has memory available for two FREQUENCIES, a control buss is provided which accesses the eighth memory address bit.

This control buss is operated through Nand gate A21 and follows the noted convention: When the simplex bit = 0 (duplex), Nand gate outputs on Pin 10 and 4 are high, enabling the gate output on Pin 1. This gate will follow the Rx/Tx status by pulling down to 0 when the 9V Rx buss is high.

When the simplex bit = 1 (simplex), the Nand gate output from Pin 10 will follow the A/B switch, outputting a 0 when the A/B switch line = 1 (CH A).

5.6.5 INTERNAL PROGRAMMING

Late model versions of the SEA 112 (S/N J-1001 and higher) allow internal programming of the first eight bands (2 MHz bands) for one frequency pair per band switch position. There are eight sets of 8 frequency pairs (64 total) available in the frequency memory. These 8 frequency pairs would normally be available through the channel switch (switch positions 1 - 8) for each of the first eight band switch positions. Due to antenna bandwidths at low frequencies, it is desirable to limit each position of the band switch to one frequency pair since the antenna coupler has 12 positions and follows the band switch.

The internal dip switch programmer functions much as an internal channel switch to allow the radio to be set up internally on one frequency pair for each of the first 8 band switch positions. Consult the channel chart for the frequencies actually programmed into the radio.

5.6.5.1 THEORY

The prom array which determines operating frequency is located on the counter PCB. This array has 8 address input lines. Four lines are inputs from the front panel band switch, one line is either an A/B bit (simplex), or a T/R bit (duplex). The remaining three lines are channel bits and are derived in the highest four bands from the octal coded front panel channel selector switch. On the lower eight bands, the front panel channel switch is disabled and channel information is provided for the prom arrray through the program circuit illustrated.

In this circuit, front panel band switch code is applied to the code converter prom which is burned to provide one low state output for each of the lower eight bands. This logic is inverted and buffered through a transistor to provide a high current source of +5 volts to the diode/dip switch channel selector. Three individual switches are weighted to provide the octal entry code. Band 1 channel selector is illustrated below. By manipulation of the three switches, eight different channels may be manually entered on each of the first eight bands.

5.6.5.2 PROGRAMMING

Refer to Figure 7A, 7B, and sample frequency card 7C.

The dip switch lines are "octal" encoded 0-7 (8 lines) with a weighting of 1, 2, and 4. To the left of each dip switch are the band switch numbers for that section of 3 switch. Left throw (off) of the switch is a "zero". Right throw (on) is a "one".

Thus as an example on band one (1) to enable channel zero (0), all three switches would be off. (0 0 0)

For "octal" number 5, switch (1) and switch (4) would be on with switch 2 off. To enable KOW Seattle, 2522/2126, on band 8, look at the prom card and see that this frequency is located on channel (octal number) 2, so that opposite band 8, the 2 switch would be turned to the "on" position.

FIGURE 7C SAMPLE FREQUENCY CARD

"A" SIMPLEX OR DUPLEX RX	"B" SIMPLEX OR DUPLEX TX	BAND	ADDRESS	USE "A"	USE "B"
2006.0	2003.0	1	6	AK ZONE 1	AK ZONE 5
2566.0 D	2031.5	5	6	KTJ COOS BAY	
2054.0	2065.0	2	4	CANADA WX	INTRSHIP
2079.0	2082.5	3	4	INTRSHIP	INTRSHIP
2093.0	2096.5	1	5	FISH INTRSHIP	LMTD COAST
		2	2		
		4	4		
2115.0	2118.0	2	6	AK ZONE 2	AK ZONE 4
		5	1		
2182.0	2182.0	1	0	DISTRESS & CALLING	
		1	1		
2182.0	2142.0	1	2	DISTRESS	CALIF. INTRSHIP
		1	4		
		2	5		
2309.0 D	2131.0	2	3	RCA KODIAK	
		8	2		
2522.0 D	2126.0	3	6	KOW SEATTLE	
2312.0 D	2134.0	3	3	RCA SITKA/COLD BAY	
		6	0		
		7	2		
2530.0 D	2134.0	8	6	KBP HONOLULU	
2598.0 D	2206.0	4	6	KFX ASTORIA	
2397.0 D	2237.0	6	2	RCA KETCHIKAN, CORDOVA	
		7	0		
		8	1		
2400.0 D	2240.0	5	2	RCA JUNEAU, NOME	
		3	0		

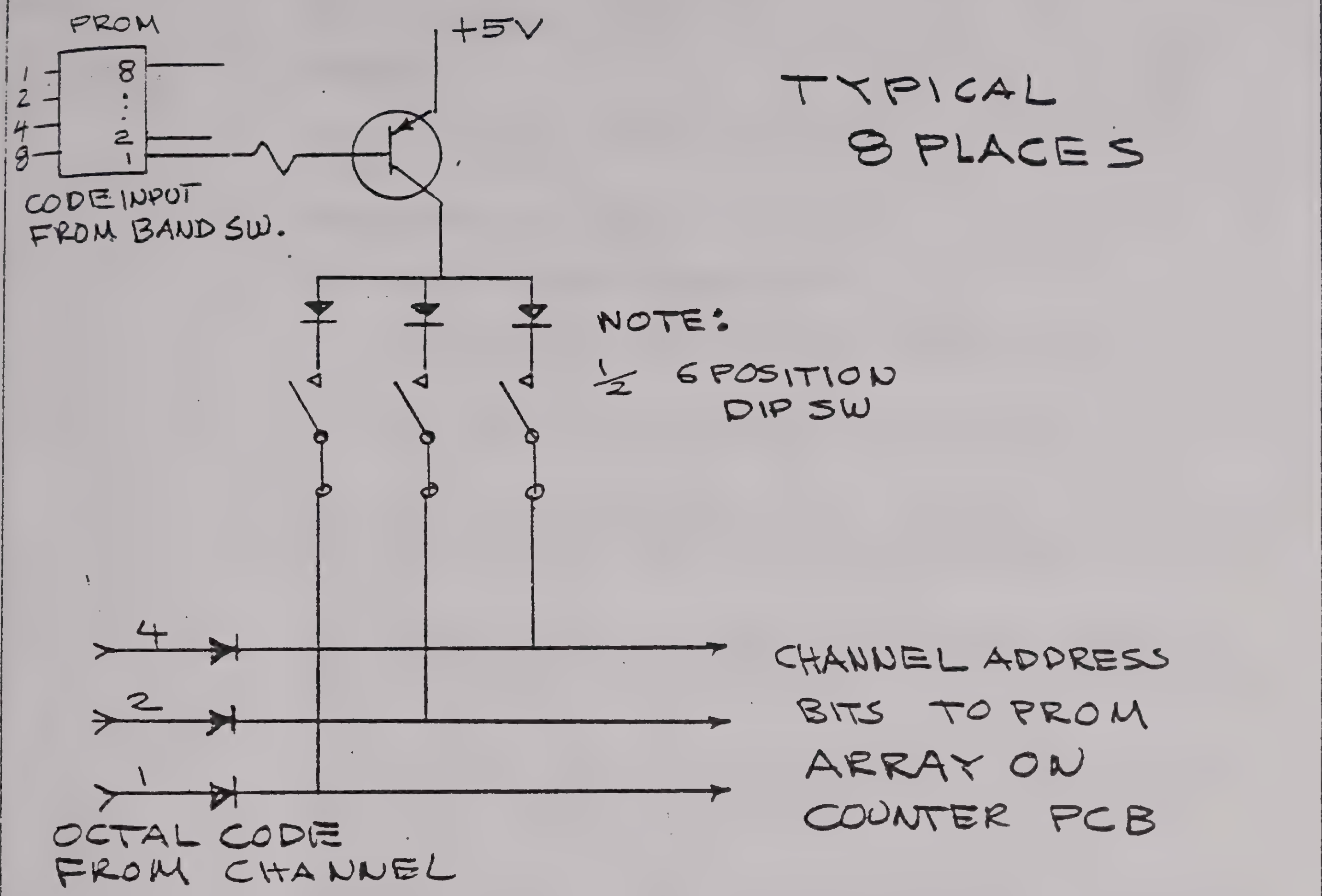


FIGURE 7A

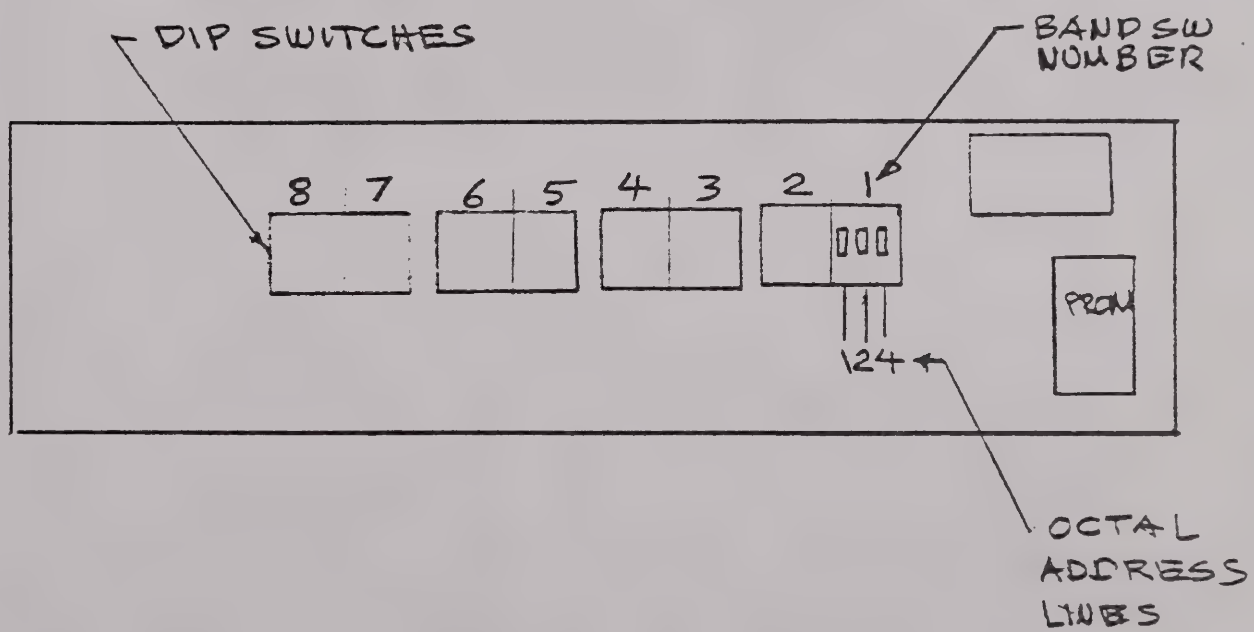


FIGURE 7B

6. MODE AND FREQUENCY CONTROL

6.1 GENERAL

Figure 9 shows a simplified schematic of the mode and frequency control circuitry.

6.2 TRANSMIT MODE SELECTION

There are two modes of transmission:

A3J (true SSB) with the carrrier suppressed by at least 40 dB

A3A (SSB) with a pilot carrier 16 dB below PEP

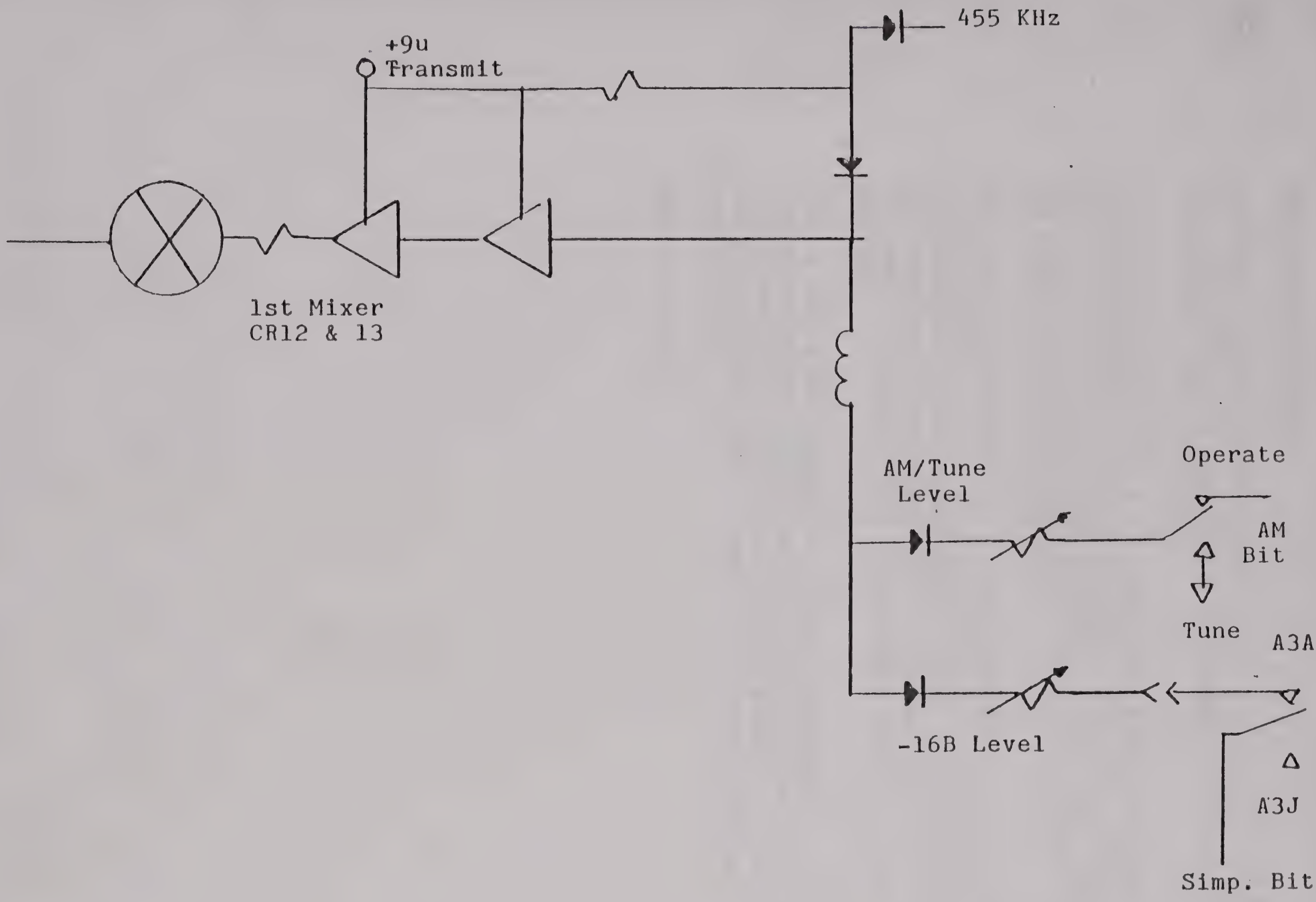
The basic mode of transmission is A3J. This mode of operation is used for ship to ship, base station to ship, and point to point communication.

A3A is used primarily for public correspondence channels. This allows the shore station to lock on to the pilot carrier with an auto tune receiver.

In the SEA 112, the normal mode is always A3J. That is, unless some sort of alteration in the basic memory program is made, the set will operate in the A3J mode.

A3A operation is only available on channels internally programmed for DUPLEX operation, and only then when desired by the operator. This is true because the memory normally will contain a "1" in the "SIMPLEX" bit position. This "1" disables 2Q13 through Nand gate output on Pin 4. In duplex the simplex bit = 0, which will turn 2Q13 on through a "1" on gate output on Pin 4. This "duplex" output is connected through front panel switch S4 to the -16 dB carrier pot on the RF PC board. Thus, when switch S4 is in the A3A position <u>and</u> the memory simplex bit = 0, carrier is reinserted to the -16 dB level.

FIG 9



SEA 112
Mode Control
Block Diagram

7. THE UP-DOWN CONVERTER

The SEA 112 makes use of the VHF first IF frequency (21.4 MHz). Such a high first IF has several advantages in equipment for the HF spectrum. See Figure 10.

With the first IF at 21.4 MHz, the image frequencies are all completely above the desired HF range (2-13 MHz), permitting the use of switched low pass filters as "front end" selectivity. This results in a considerable simplification in overall design and yields improved results as well.

When the VCO is employed in a wide frequency range transceiver such as the SEA 112, it is usually necessary to use several oscillators with overlapping ranges, owing to the large PERCENT-AGE bandwidth (1000%) span. With a 21.4 MHz first IF, a single VCO covering the span of 23-35 MHz easily covers the entire HF spectrum.

While a single VHF crystal oscillator is employed in the conversion scheme of the up-down converter, it in no way contributes to the overall frequency stability of the SEA 112. The method used to accomplish this is described in detail elsewhere in this manual (5.4.1).

Refer to Figure 11.

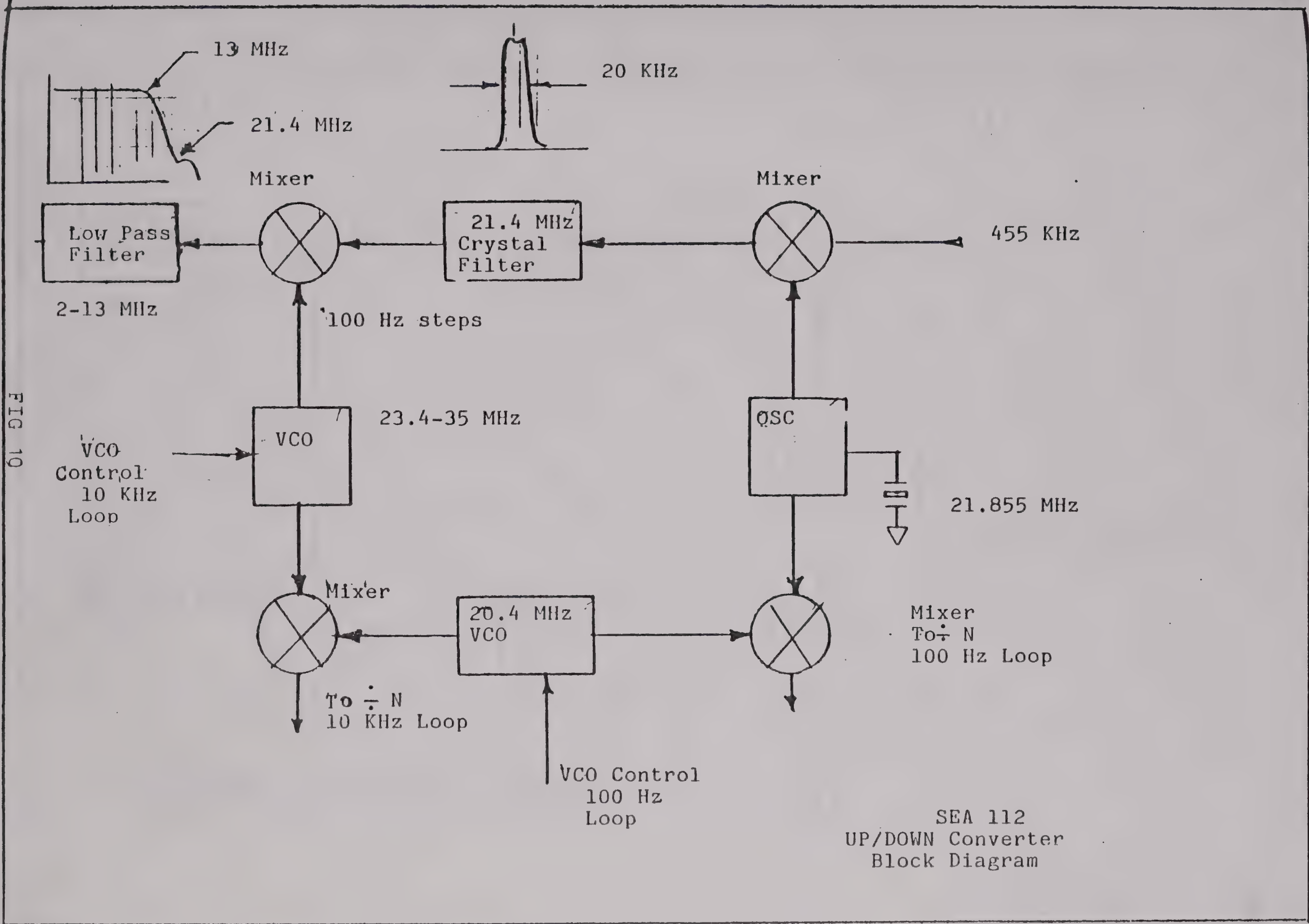
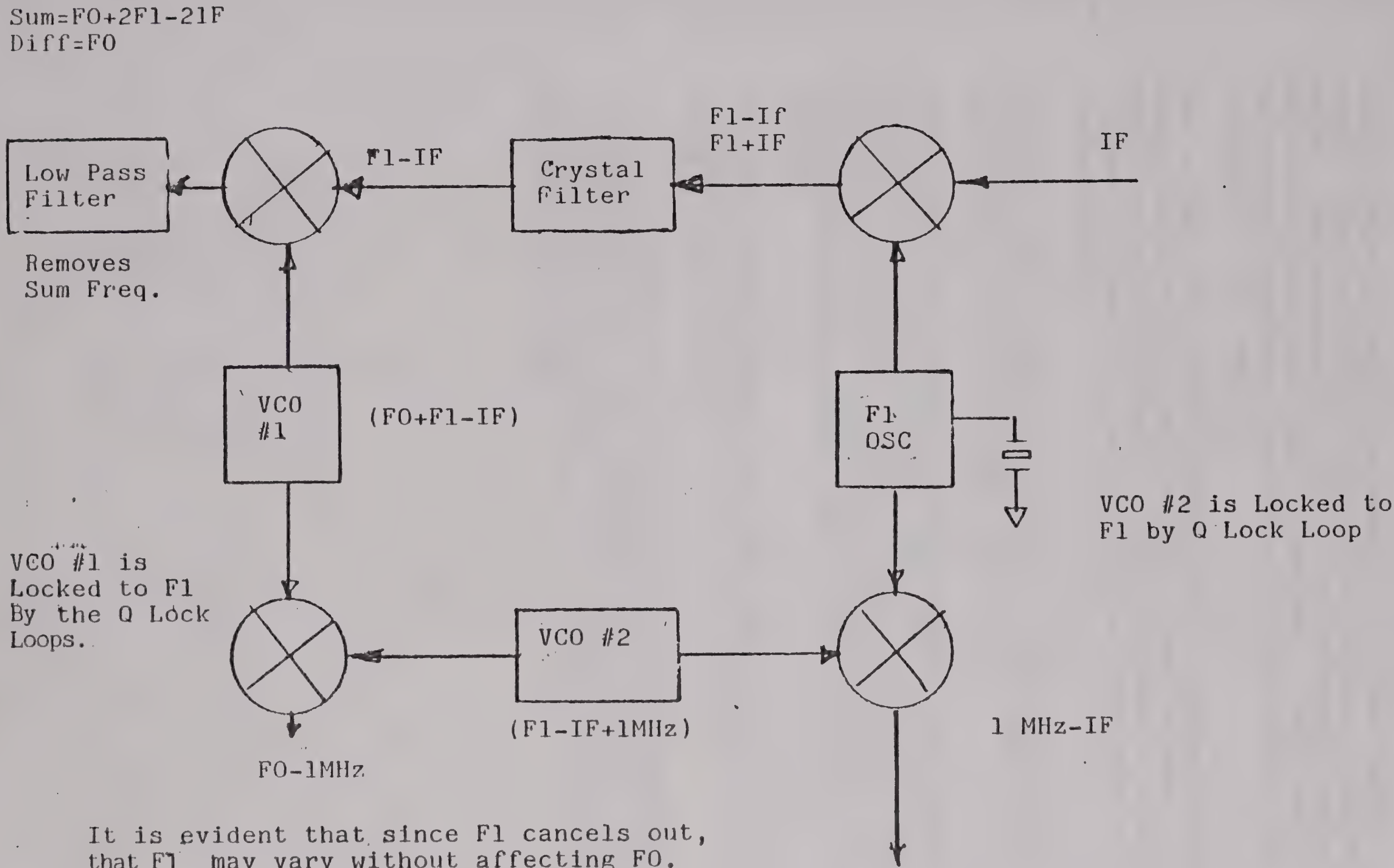


FIG 10

SEA 112
UP/DOWN Converter
Block Diagram



It is evident that since F1 cancels out, that F1 may vary without affecting FO.

Sea 112
Frequency Error
Cancelling

FIG 11

8. THE POWER SUPPLY CIRCUIT

Figure 12 shows a simplified schematic of the power supply circuit. The basic supply is a 13.6 V DC negative ground power source. When operation from other voltage sources is desired, the use of an external power supply is necessary. ON/OFF control for such external accessories is provided by a remote switch line in the unit (P2, pin 5 and 6).

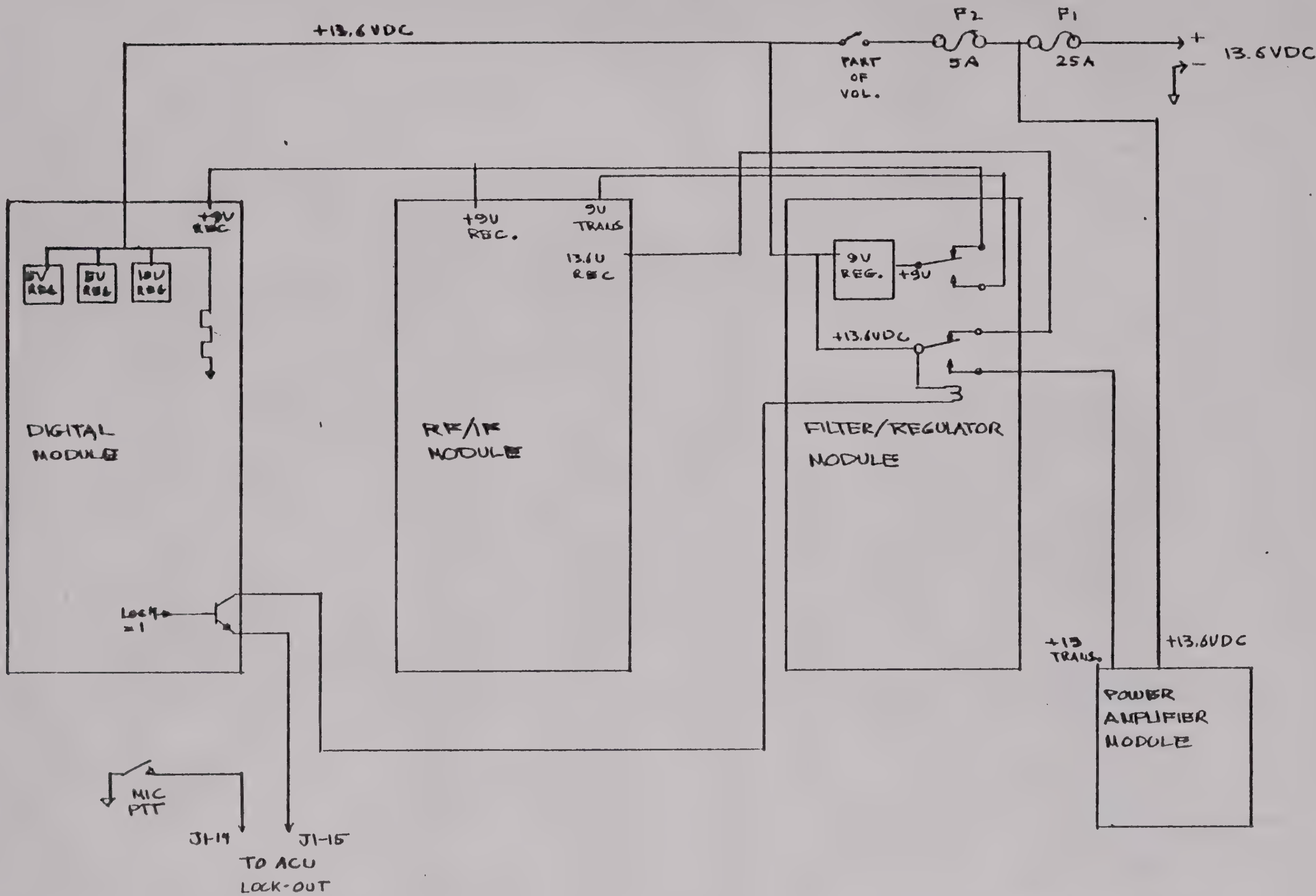
Once the basic 13.6 V DC is provided, it is connected to the set through the heavy duty power plug, P2, on the rear panel. Two fuses are provided to protect the set in the event of malfunction. A protection diode, CR3, opens the 25A fuse in the event of reversed polarity.

The ON/OFF switch is part of the volume control potentiometer. From this buss, all other voltages are derived EXCEPT the high current buss to the final output transistors.

Several regulators, located on various printed circuit boards, distribute the required voltages. The +9 V buss, the +9 V Rx buss and the +9 V Tx buss are derived from the +9 V regulator located on the filter board. The T/R relay is used to generate the receive and transmit voltages, both the +9 V busses and the +13.6 V busses.

The counter board contains three regulators. One is the +10 buss required for the CMOS logic and the two +5 V regulators for the memory and TTL circuitry.

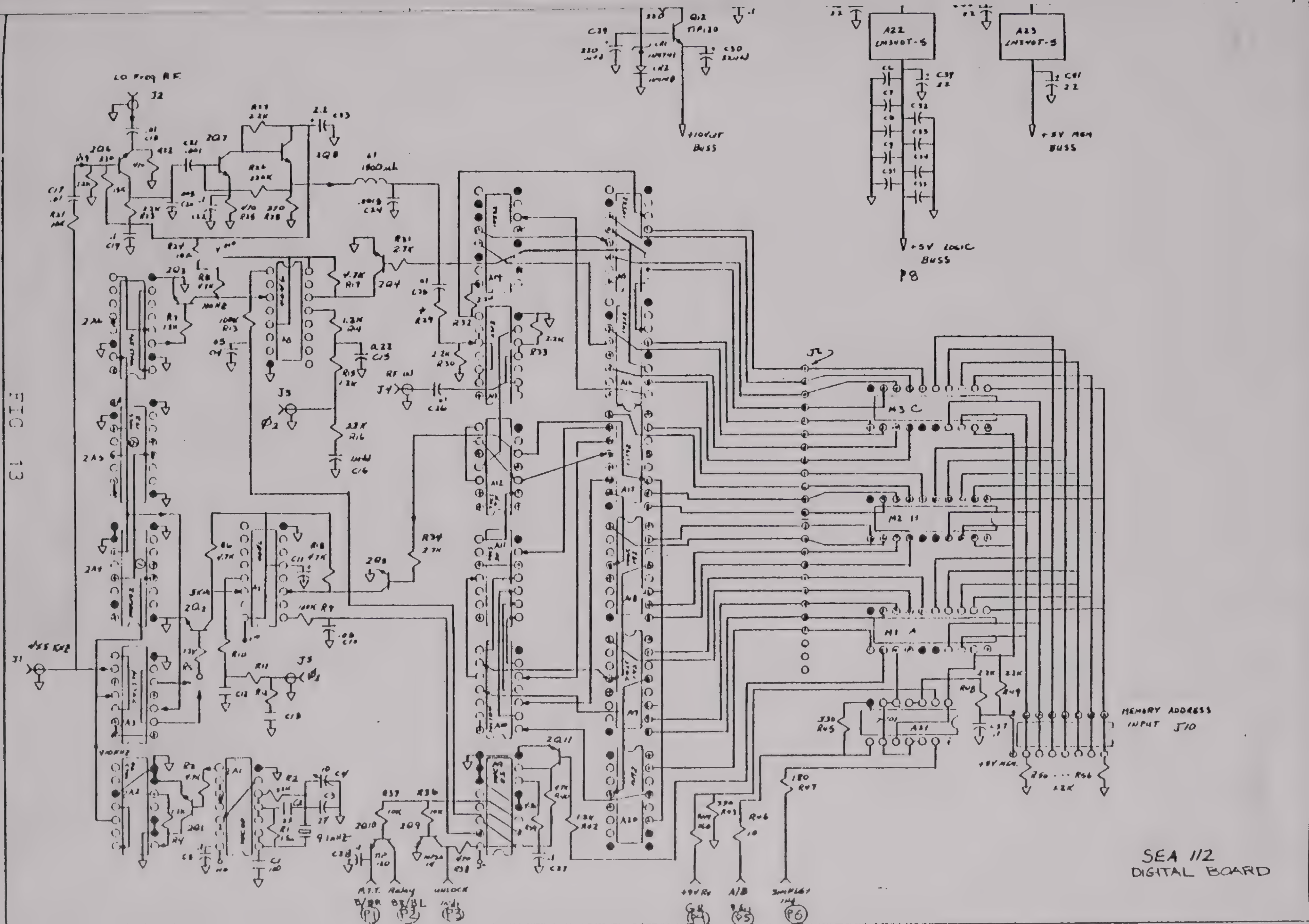
The use of separate +5 V regulators is helpful in reducing board-to-board interference from high speed logic "glitches" which tend to radiate from power wiring. The +5 V regulator on the counter board provides all the "on board" +5 V needed in the TTL logic counters on that board.



SEA 112
POWER CONTROL
&
TRANSMIT INTERLOCK
BLOCK DIAGRAM

FIG 11

SEA 112
POWER CONTROL
&
TRANSMIT INTERLOCK
BLOCK DIAGRAM



SEA 112
DIGITAL BOARD

FIG 13

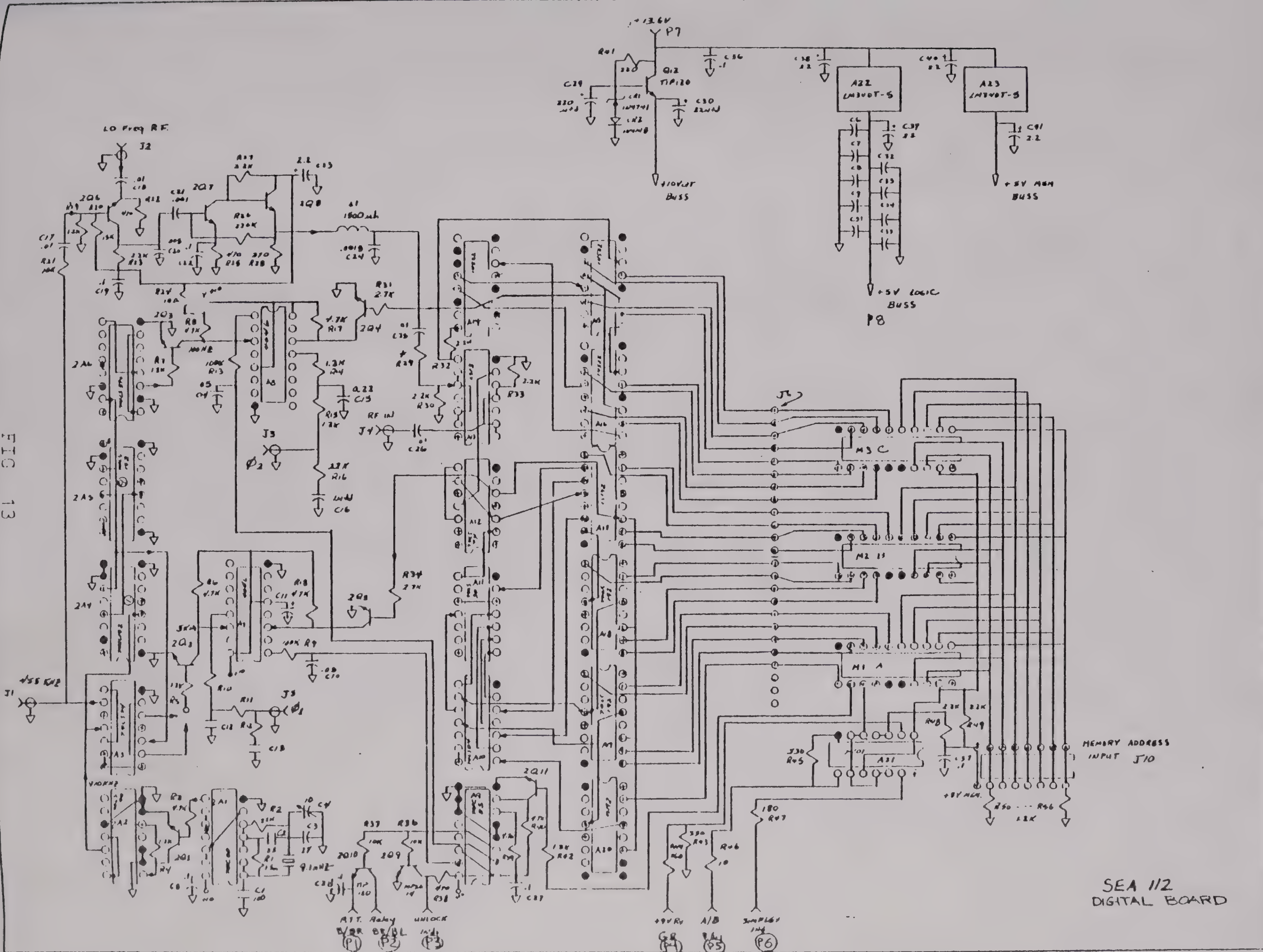

+13.6V
P7
Q12
TIP120
A22
LM340T-5
A23
LM340T-5
+5V MEM BUSS
+5V LOGIC BUSS
P8
LO Freq R.F.
J2
1500 uh
RF IN
J4
J3
455 KHZ
J1
M3 C
M2 B
M1 A
A31
MEMORY ADDRESS INPUT J10
ATT. Relay
UNLOCK
A/B
SIMPLEX
SEA 112
DIGITAL BOARD

FIG 13

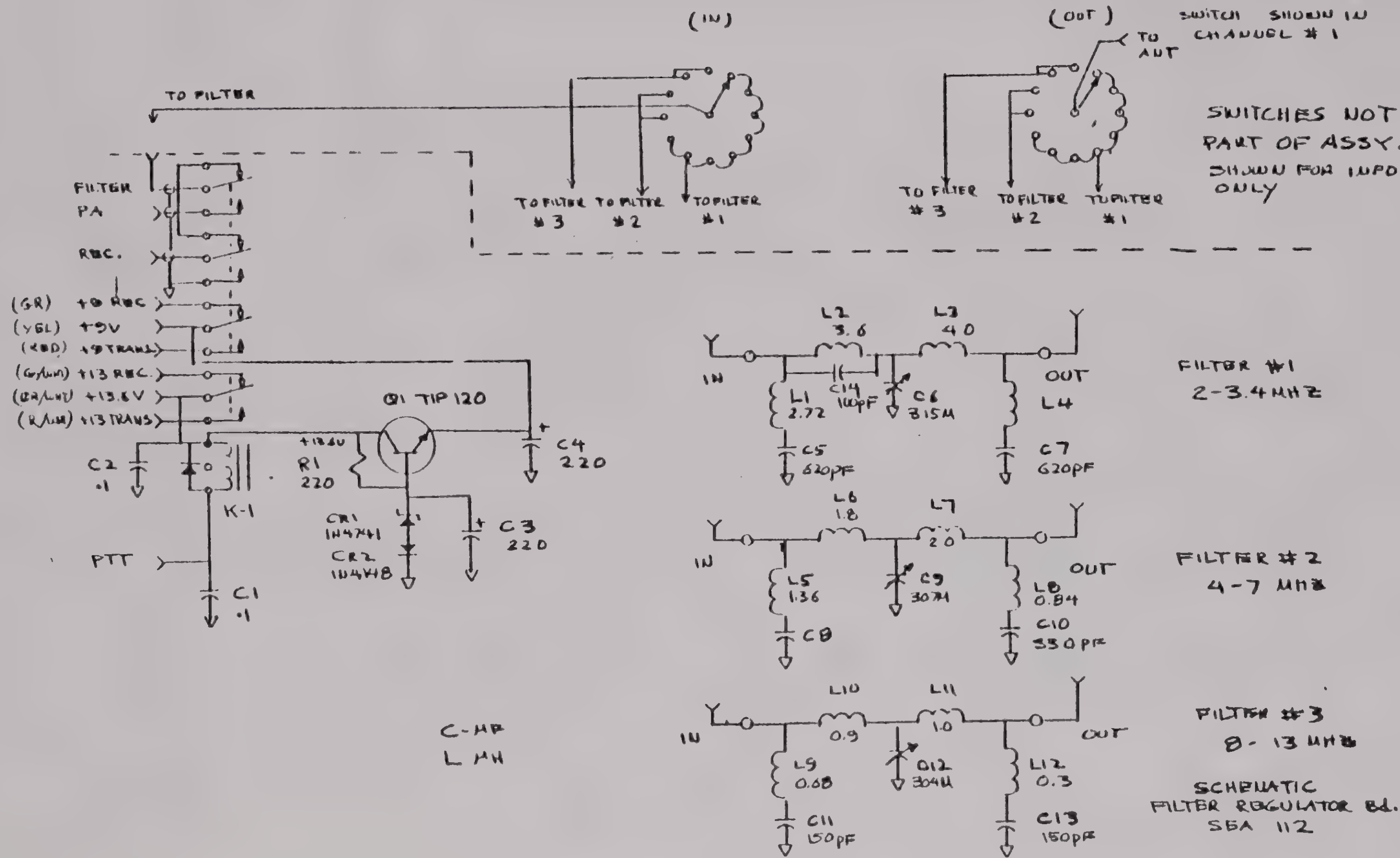

(IN)
(OUT)
SWITCH SHOWN IN CHANNEL # 1
TO ANT
TO FILTER
SWITCHES NOT PART OF ASSY.
SHOWN FOR INFO ONLY
TO FILTER #3
TO FILTER #2
TO FILTER #1
FILTER
PA
REC.
(GR) +to REC
(YEL) +5V
(RED) +9 TRANS
(G/WH) +13 REC.
(BR/WH) +13.6V
(R/WH) +13 TRANS
Q1 TIP 120
+13.6V
R1 220
C4 220
C2 .1
K-1
CR1 1N4741
CR2 1N4148
C3 220
PTT
C1 .1
L2 3.6
L3 4.0
IN
OUT
L1 2.72
C14 100pF
C6 315M
L4
C5 620pF
C7 620pF
FILTER #1
2-3.4 MHZ
L6 1.8
L7 2.0
L5 1.36
C9 307M
L8 0.84
C8
C10 330pF
FILTER #2
4-7 MHZ
L10 0.9
L11 1.0
L9 0.68
C12 304M
L12 0.3
C11 150pF
C13 150pF
FILTER #3
8-13 MHZ
C-MF
L MH
SCHEMATIC
FILTER REGULATOR Bd.
SEA 112

FIG 14

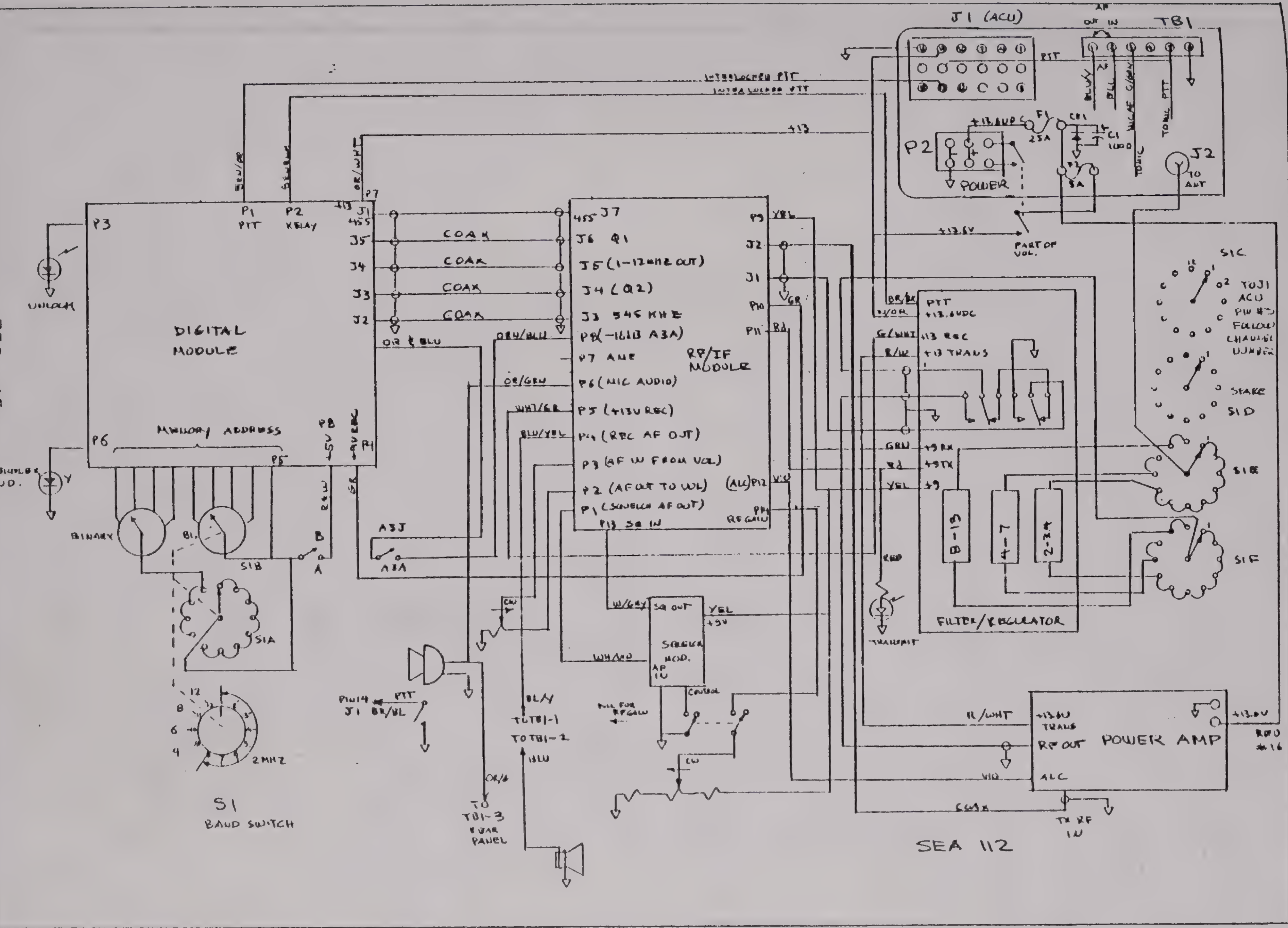
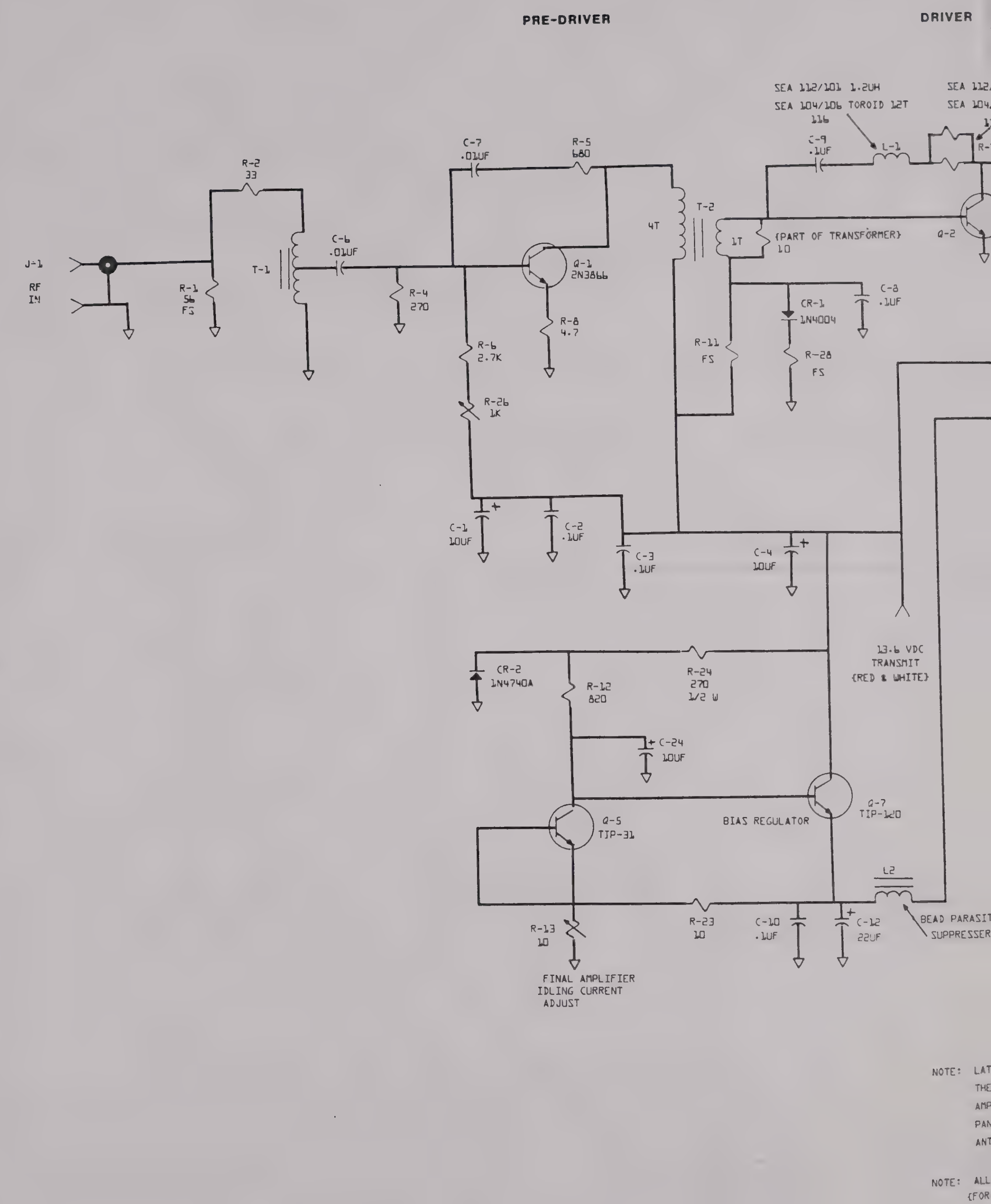
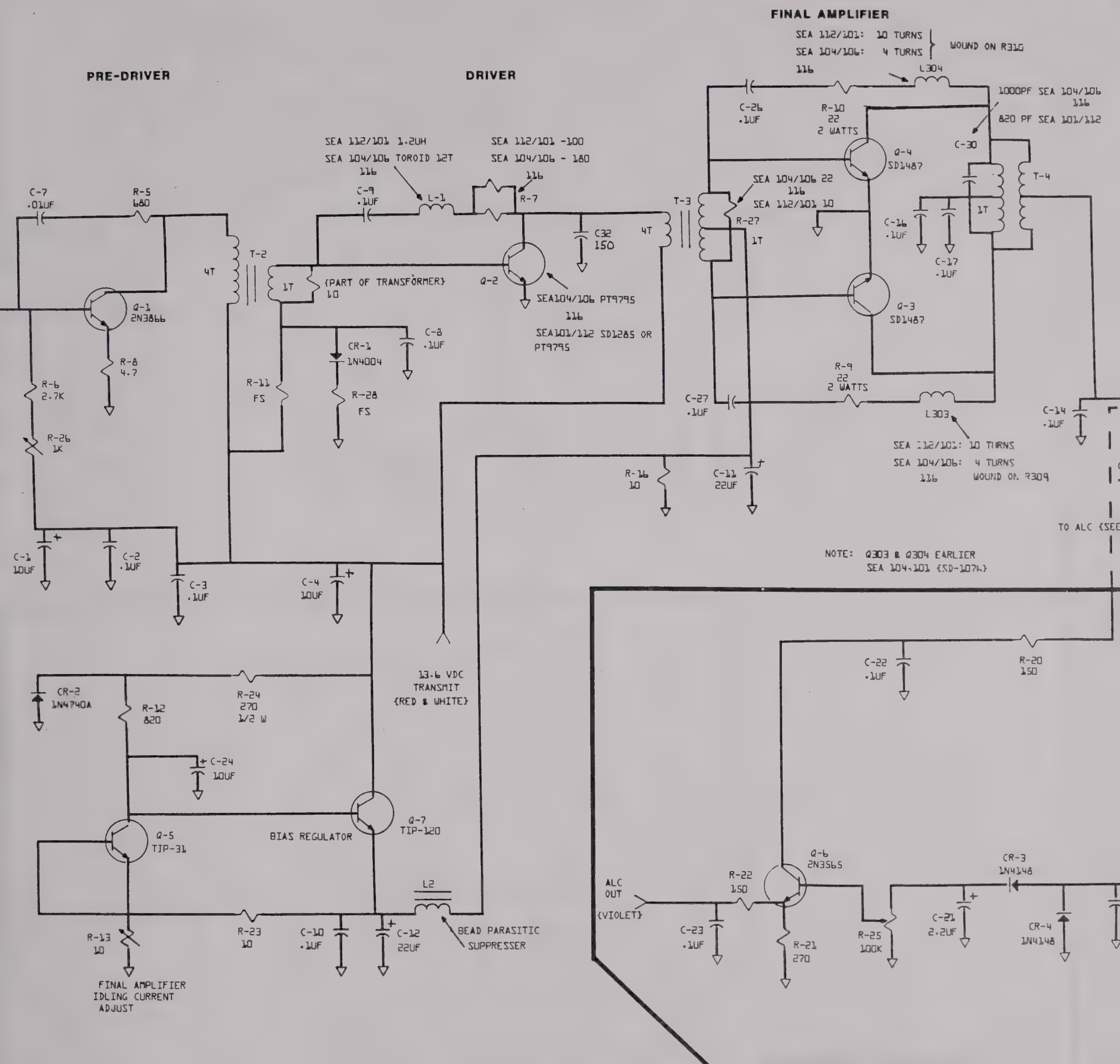

J1 (ACU)
TB1
AF OUT IN
PTT
INTERLOCKED PTT
+13
P2
POWER
F1 25A
CB1
C1 1000
F2 5A
J2 TO ANT
TUNE PTT
P3
UNLOCK
P1 PTT
P2 RELAY
P7
J1 455
J5
J4
J3
J2
COAX
COAX
COAX
COAX
DIGITAL MODULE
J7
455
J6 Q1
J5 (1-12MHZ OUT)
J4 (Q2)
J3 545 KHZ
P8 (-16.1B A3A)
P7 AME
RF/IF MODULE
P6 (MIC AUDIO)
P5 (+13V REC)
P4 (REC AF OUT)
P3 (AF IN FROM VOL)
P2 (AF OUT TO VOL)
P1 (SQUELCH AF OUT)
P13 SQ IN
(ALC) P12
RF GAIN
P9 YEL
J2
J1
P10
P11
+13.6V
PART OF VOL.
MEMORY ADDRESS
P6
P5
P8 +5V
P4
SIMPLEX IND.
BINARY
S1B
A3J
A3A
S1A
S1 BAND SWITCH
2MHZ
PTT
+13.6VDC
+13 REC
+13 TRANS
GRN +9RX
+9TX
YEL +9
8-13
4-7
2-3.4
FILTER/REGULATOR
TRANSMIT
S1C
S1D
S1E
S1F
SPARE
SQ OUT
YEL
+9V
SQUELCH MOD.
AF IN
CONTROL
TO TB1-1
TO TB1-2
TO TB1-3 REAR PANEL
R/WHT
+13.6V TRANS
RF OUT
POWER AMP
ALC
COAX
TX RF IN
+13.6V
SEA 112

FIG. 15

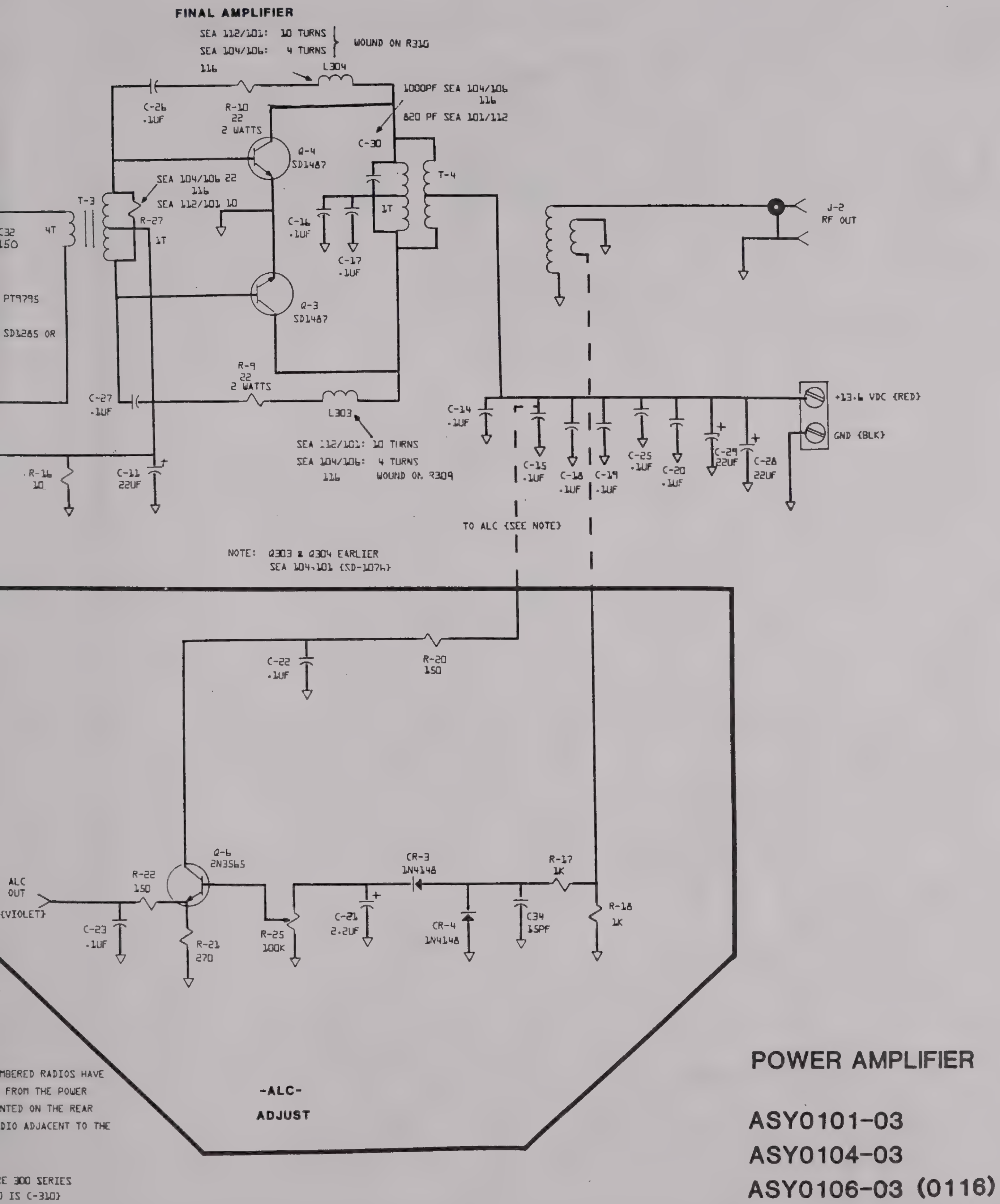
DATE 11/26/80
REDRAWN





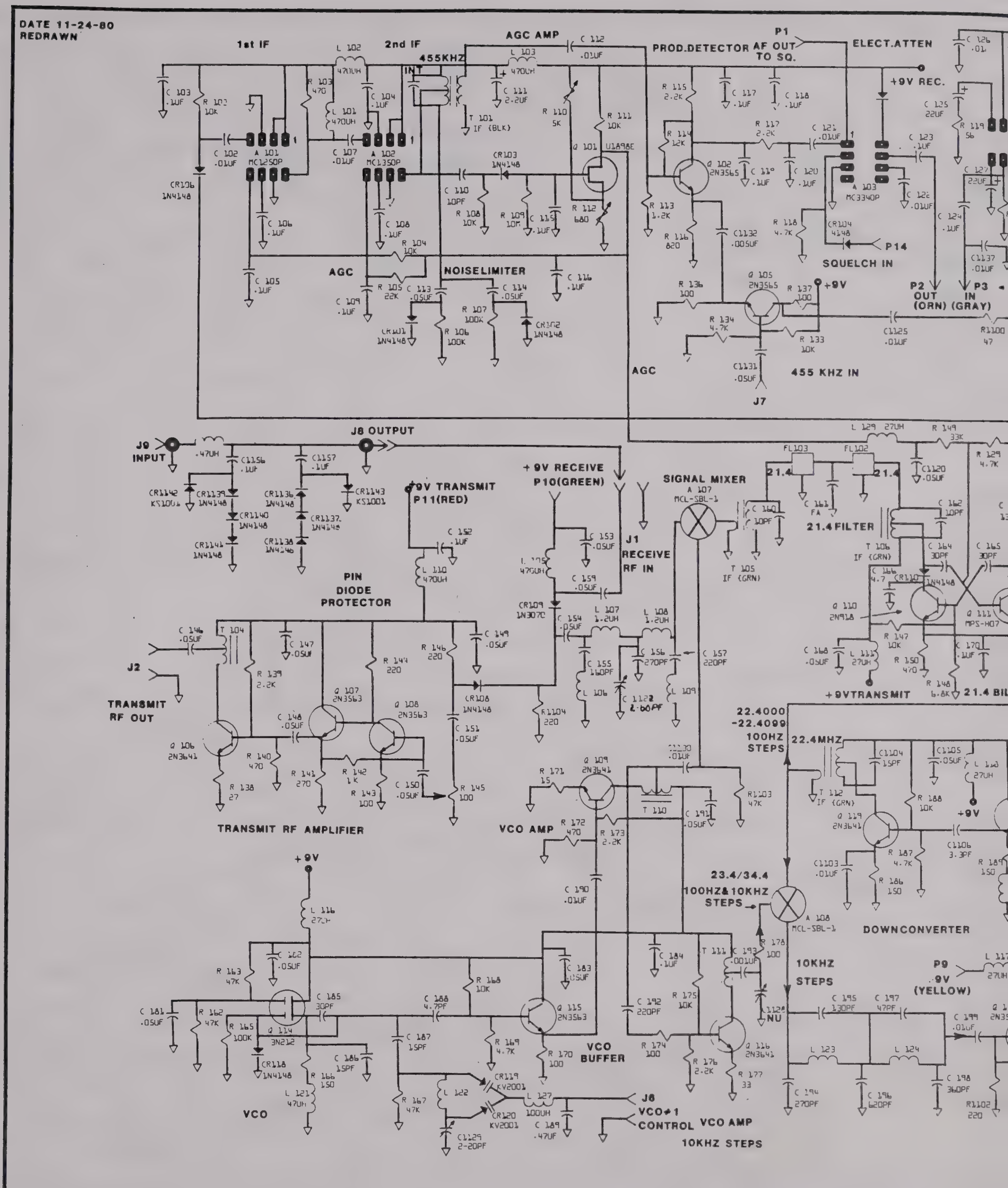
NOTE: LATER SERIAL NUMBERED RADIOS HAVE THE ALC DELETED FROM THE POWER AMPLIFIER & MOUNTED ON THE REAR PANEL OF THE RADIO ADJACENT TO THE ANTENNA JACK

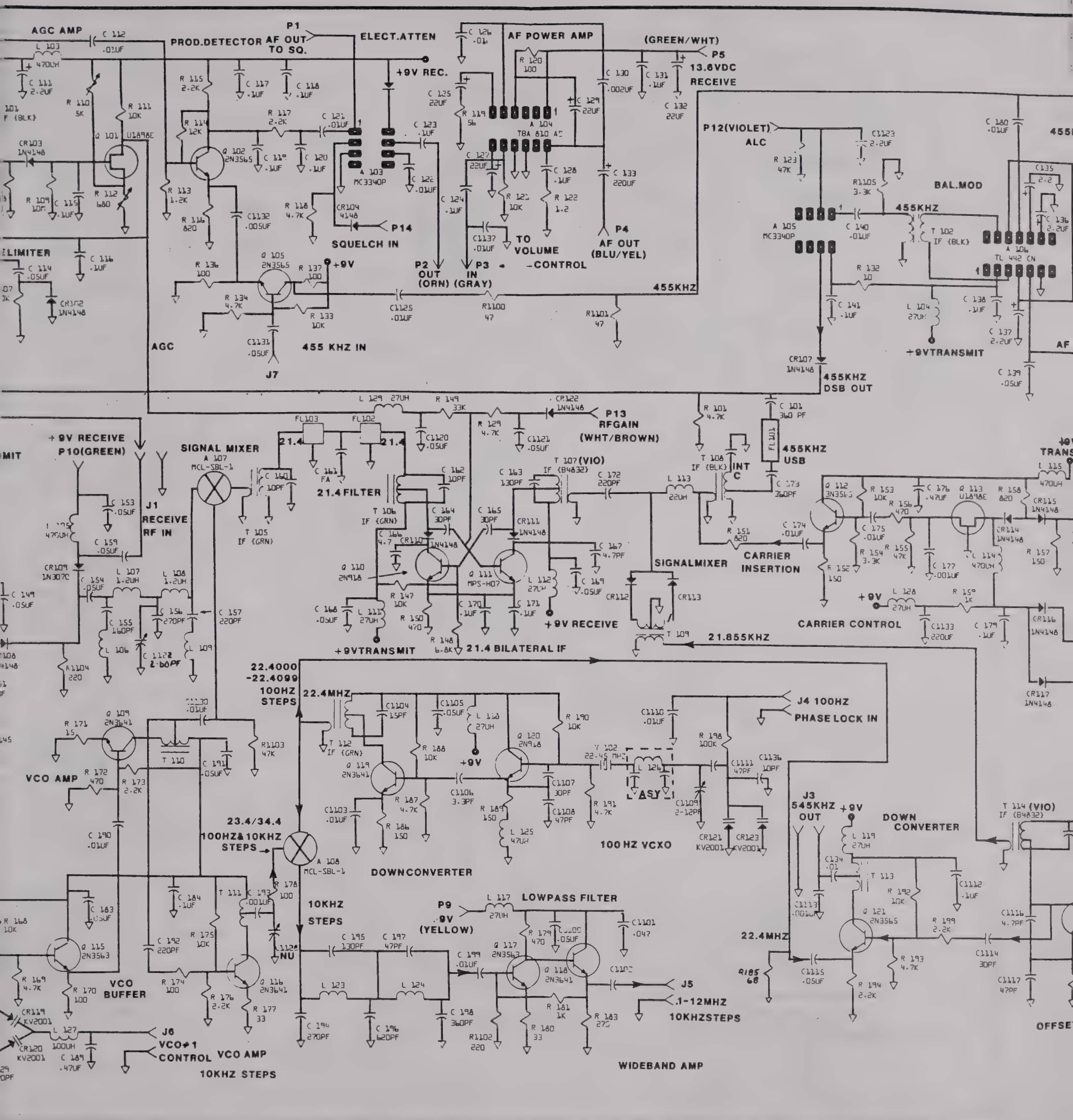
NOTE: ALL REF. DES. ARE 300 SERIES (FOR EXAMPLE C-10 IS C-310)



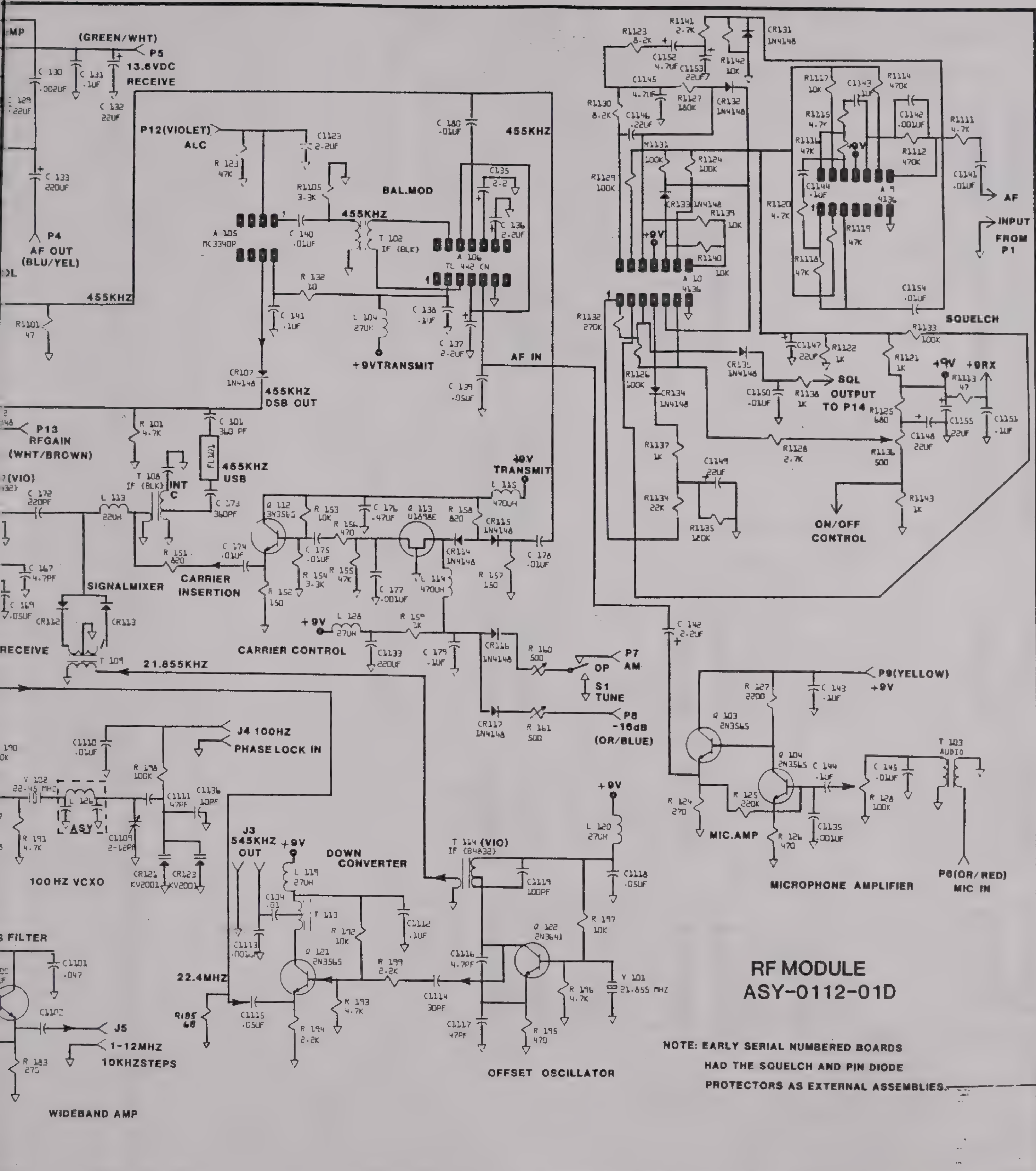
POWER AMPLIFIER

ASY0101-03
ASY0104-03
ASY0106-03 (0116)
ASY0112-03


DATE 11-24-80
REDRAWN
1st IF
2nd IF
455KHZ
AGC AMP
PROD.DETECTOR
P1
AF OUT
TO SQ.
ELECT.ATTEN
+9V REC.
A 101 MC1350P
A 102 MC1350P
T 101 IF (BLK)
Q 101 U1898E
Q 102 2N3565
A 103 MC3340P
AGC
NOISELIMITER
SQUELCH IN
P14
P2 OUT (ORN)
P3 IN (GRAY)
Q 105 2N3565
455 KHZ IN
J7
J9 INPUT
J8 OUTPUT
+9V RECEIVE P10(GREEN)
+9V TRANSMIT P11(RED)
SIGNAL MIXER
A 107 MCL-SBL-1
J1 RECEIVE RF IN
21.4 FILTER
T 105 IF (GRN)
T 106 IF (GRN)
Q 110 2N918
Q 111 MPS-H07
PIN DIODE PROTECTOR
J2
TRANSMIT RF OUT
Q 106 2N3641
Q 107 2N3563
Q 108 2N3563
TRANSMIT RF AMPLIFIER
+9VTRANSMIT
21.4 BIL
22.4000 -22.4099 100HZ STEPS
22.4MHZ
T 112 IF (GRN)
Q 119 2N3641
DOWNCONVERTER
Q 109 2N3641
VCO AMP
T 110
23.4/34.4 100HZ& 10KHZ STEPS
A 108 MCL-SBL-1
10KHZ STEPS
P9 9V (YELLOW)
+9V
Q 114 3N212
Q 115 2N3563
VCO BUFFER
Q 116 2N3641
VCO
J6
VCO#1 CONTROL
VCO AMP 10KHZ STEPS

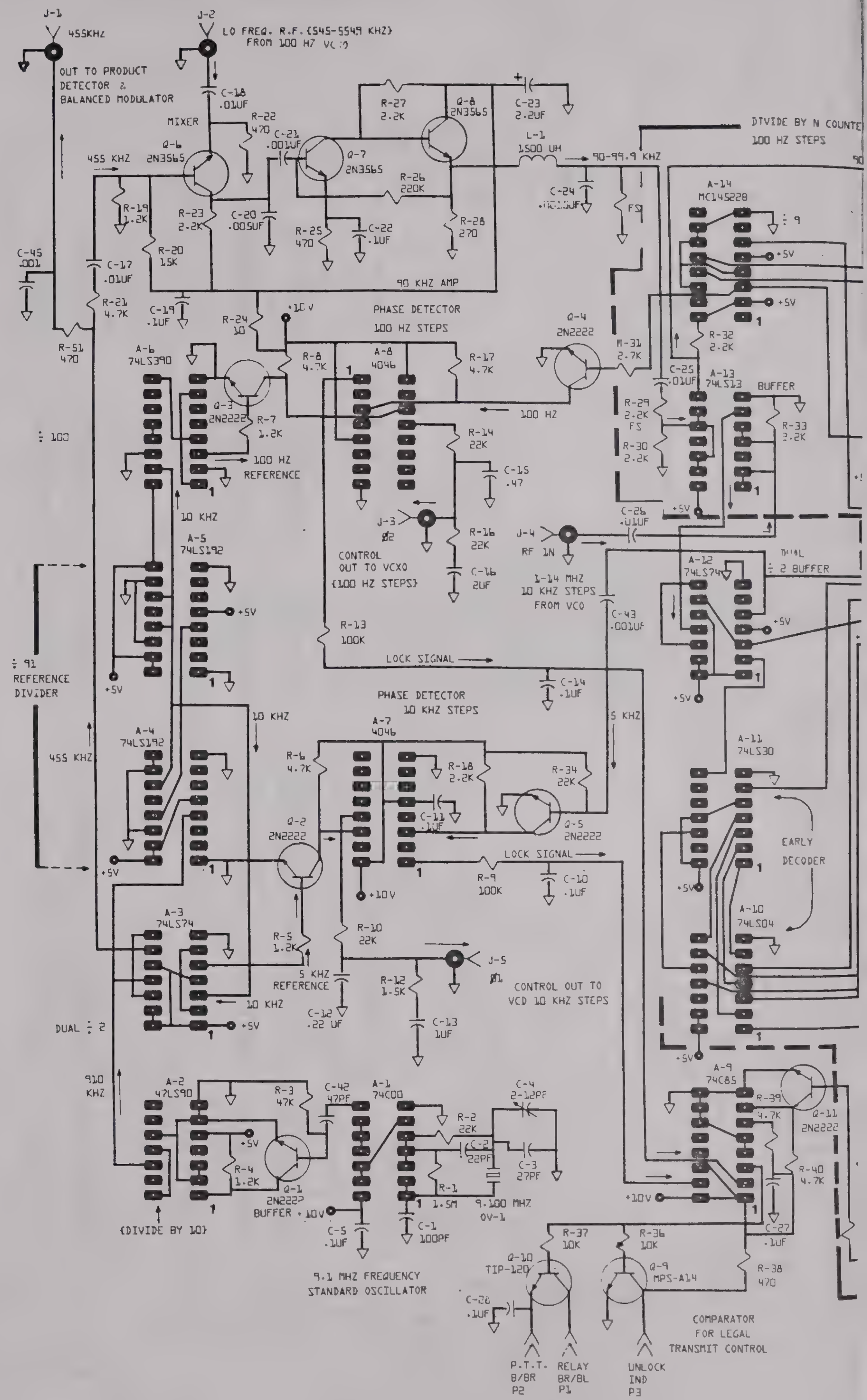


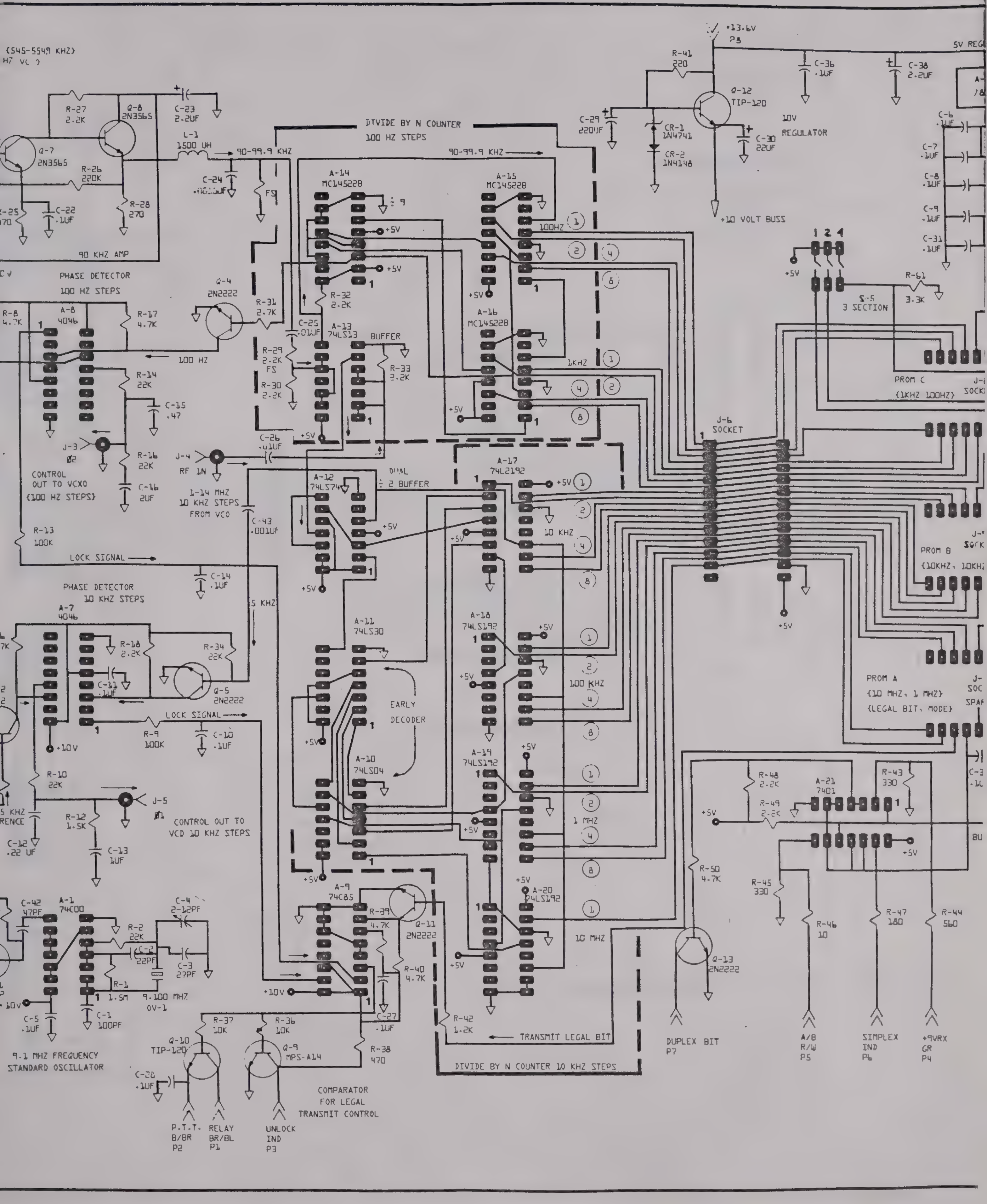
AGC AMP
PROD.DETECTOR
AF OUT TO SQ.
ELECT.ATTEN
AF POWER AMP
(GREEN/WHT)
P5
13.6VDC RECEIVE
+9V REC.
P12(VIOLET) ALC
BAL.MOD
455KHZ
SQUELCH IN
P14
P2 OUT (ORN)
P3 IN (GRAY)
TO VOLUME CONTROL
P4 AF OUT (BLU/YEL)
LIMITER
AGC
455 KHZ IN
J7
+9VTRANSMIT
455KHZ DSB OUT
P13 RFGAIN (WHT/BROWN)
+9V RECEIVE P10(GREEN)
SIGNAL MIXER
J1 RECEIVE RF IN
21.4 FILTER
455KHZ USB
SIGNALMIXER
CARRIER INSERTION
CARRIER CONTROL
21.4 BILATERAL IF
+9V RECEIVE
21.855KHZ
22.4000 -22.4099 100HZ STEPS
22.4MHZ
J4 100HZ PHASE LOCK IN
VCO AMP
100 HZ VCXO
J3 545KHZ OUT
DOWN CONVERTER
23.4/34.4 100HZ&10KHZ STEPS
DOWNCONVERTER
10KHZ STEPS
P9 9V (YELLOW)
LOWPASS FILTER
22.4MHZ
VCO BUFFER
J5 .1-12MHZ 10KHZSTEPS
J6 VCO#1 CONTROL
VCO AMP 10KHZ STEPS
WIDEBAND AMP
OFFSET



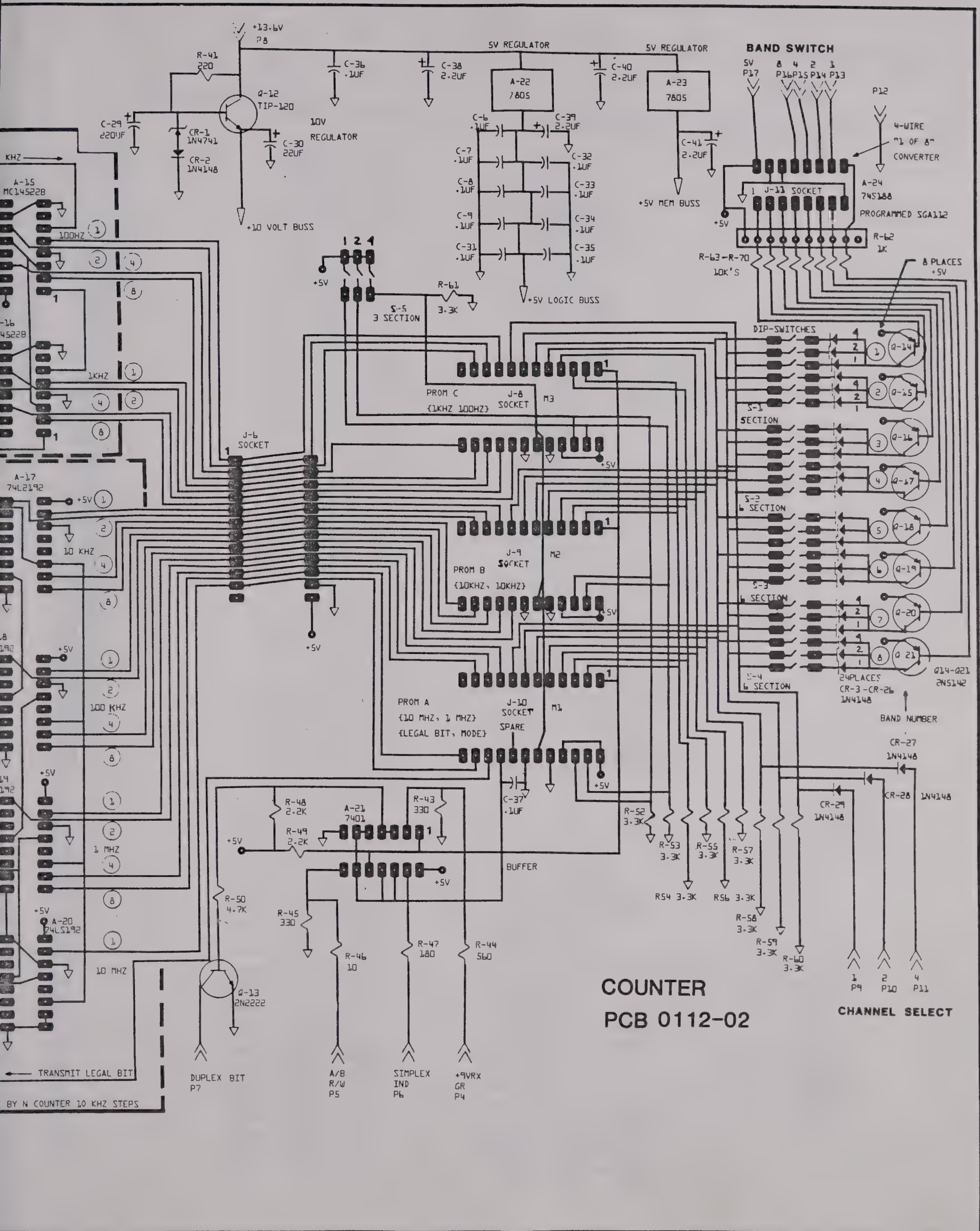
(GREEN/WHT)
P5
13.6VDC
RECEIVE
P4
AF OUT
(BLU/YEL)
455KHZ
P12(VIOLET)
ALC
BAL.MOD
455KHZ
A 105
MC3340P
T 102
IF (BLK)
A 106
TL 442 CN
+9VTRANSMIT
AF IN
CR107
1N4148
455KHZ
DSB OUT
P13
RFGAIN
(WHT/BROWN)
T 108
IF (BLK)
INT C
FL101
455KHZ
USB
+9V
TRANSMIT
Q 112
2N3565
Q 113
U1898E
CR115
1N4148
CR114
1N4148
SIGNALMIXER
CARRIER
INSERTION
CR112
CR113
RECEIVE
T 109
21.855KHZ
CARRIER CONTROL
CR116
1N4148
P7
OP
AM
S1
TUNE
CR117
1N4148
P8
-16dB
(OR/BLUE)
J4 100HZ
PHASE LOCK IN
Y 102
22.45 MHZ
ASY
CR121
KV2001
CR123
KV2001
100 HZ VCXO
J3
545KHZ
OUT
+9V
DOWN
CONVERTER
T 113
Q 121
2N3565
22.4MHZ
T 114 (VIO)
IF (B4832)
+9V
Q 122
2N3641
Y 101
21.855 MHZ
OFFSET OSCILLATOR
S FILTER
J5
1-12MHZ
10KHZSTEPS
WIDEBAND AMP
CR131
1N4148
CR132
1N4148
CR133 1N4148
A 10
4136
A 9
4136
AF
INPUT
FROM
P1
SQUELCH
CR135
1N4148
SQL
OUTPUT
TO P14
CR134
1N4148
+9V
+9RX
ON/OFF
CONTROL
P9(YELLOW)
+9V
Q 103
2N3565
Q 104
2N3565
T 103
AUDIO
MIC.AMP
MICROPHONE AMPLIFIER
P6(OR/RED)
MIC IN
RF MODULE
ASY-0112-01D
NOTE: EARLY SERIAL NUMBERED BOARDS
HAD THE SQUELCH AND PIN DIODE
PROTECTORS AS EXTERNAL ASSEMBLIES.

DATE 11-18-80
REDRAWN





(545-5549 KHZ)
90 KHZ AMP
PHASE DETECTOR
100 HZ STEPS
CONTROL
OUT TO VCXO
(100 HZ STEPS)
LOCK SIGNAL
PHASE DETECTOR
10 KHZ STEPS
CONTROL OUT TO
VCO 10 KHZ STEPS
9.1 MHZ FREQUENCY
STANDARD OSCILLATOR
DIVIDE BY N COUNTER
100 HZ STEPS
90-99.9 KHZ
RF IN
1-14 MHZ
10 KHZ STEPS
FROM VCO
DUAL
÷ 2 BUFFER
BUFFER
EARLY
DECODER
5 KHZ
COMPARATOR
FOR LEGAL
TRANSMIT CONTROL
TRANSMIT LEGAL BIT
DIVIDE BY N COUNTER 10 KHZ STEPS
P.T.T.
B/BR
P2
RELAY
BR/BL
P1
UNLOCK
IND
P3
DUPLEX BIT
P7
A/B
R/W
P5
SIMPLEX
IND
P6
+9VRX
GR
P4
+13.6V
P8
10V
REGULATOR
+10 VOLT BUSS
5V REG
J-6
SOCKET
S-5
3 SECTION
PROM C
(1KHZ 100HZ)
PROM B
(10KHZ, 10KHZ
PROM A
(10 MHZ, 1 MHZ)
(LEGAL BIT, MODE)
100HZ
1KHZ
10 KHZ
100 KHZ
1 MHZ
10 MHZ
A-14 MC145228
A-15 MC145228
A-16 MC145228
A-13 74LS13
A-12 74LS74
A-17 74LS192
A-18 74LS192
A-19 74LS192
A-20 74LS192
A-11 74LS30
A-10 74LS04
A-9 74C85
A-8 4046
A-7 4046
A-1 74C00
A-21 7401
Q-4 2N2222
Q-5 2N2222
Q-7 2N3565
Q-8 2N3565
Q-9 MPS-A14
Q-10 TIP-120
Q-11 2N2222
Q-12 TIP-120
Q-13 2N2222
CR-1 1N4741
CR-2 1N4148
L-1 1500 UH



COUNTER
PCB 0112-02

STEPHENS ENGINEERING ASSOCIATES, INC.
* * * P A R T S   L I S T * * *

ISSUED	APPROVED	REV DATE	REV	ASSEMBLY NUMBER	DESCRIPTION	MODEL
05/13/80	BY DM	05/13/80	A	ASY-0112	FINAL	SEA 112

REF. DES.	PART NUMBER	DESCRIPTION & REMARKS	
ASY01	ASY-0112-00	CHASSIS	
ASY02	ASY-0112-01	RF	
ASY03	ASY-0112-03	POWER AMP	
ASY04	ASY-0112-02	COUNTER	
ASY05	ASY-0112-06	INTERFACE	
ASY09	ASY-0112-09	FILTER	
ASY10	ASY-0112-12	HARNESS	
ASY12	ASY-0112-13	PIN DIODE	
ASY13	ASY-0112-14	SQUELCH	
CAB1	WIR-0001-010	10" PHONO CABLE	
CAB2	WIR-0001-012	12" PHONO CABLE	
CON1	CON-0014-001	16 PIN CONNECTOR	
CR1	SEM-0084-001	DIODE	LED (RED)
CR2	SEM-0084-001	DIODE	LED (RED)
CR3	SEM-0084-001	DIODE	LED (RED)
CU1	COU-0002-002	COUPLING, SHAFT	
CU2	COU-0004-001	COUPLING, SHAFT	
FAB01	FAB-1500-08	FRONT PLATE	
FAB06	FAB-0112-01	OVERLAY	
FAB1	FAB-1500-06	COVER	
FAB2	FAB-1500-18	MOUNTING BRACKET	
FAB3	FAB-1500-16	GRILL	
HAR2	HAR-0018-001	KNOB, SCREW	
HAR5	HAR-0020-001	FEET	
HAR6	HAR-0061-006	FCC STICKER (112)	
HAR7	HAR-0061-007	FREQ. STICKER (101)	
KNO1	KNO-0007-001	KNOB, CONTROL	
KNO2	KNO-0007-002	KNOB, CHANNEL	
KNO3	KNO-0007-005	KNOB, POINTER	
LS 1	SPE-0001-001	SPEAKER	
M 1	SEM-0108-001	IC	74S472
M 2	SEM-0108-001	IC	74S472
M 3	SEM-0108-001	IC	74S472
MIC1	MIC-0002-004	MICROPHONE	
MIC2	MIC-0003-001	MIC HANGER	
P1	CON-0008-001	COUPLER PLUG	
P2	CON-0006-001	POWER PLUG	
R1	RES-0001-472	RESISTOR	4.7K
R2	RES-0018-001	RESISTOR, VARIABLE	10K
R3	RES-0001-222	RESISTOR	2.2K
R4	RES-0001-471	RESISTOR	470
R5	RES-0019-001	RESISTOR, VARIABLE	10K
S2	SWI-0016-001	SWITCH, BAND	
S3	SWI-0007-001	SWITCH	DPDT
S4	SWI-0007-001	SWITCH	DPDT
S5	SWI-0021-001	SWITCH, OCTAL	
SB1	BOX-0003-001	BOX, SHIPPING	
SH1	HAR-0009-001	SHAFT LEDEX	
TR4	TER-0015-001	TERMINAL STRIP	

STEPHENS ENGINEERING ASSOCIATES, INC.
* * * P A R T S   L I S T * * *

ISSUED	APPROVED	REV DATE	REV	ASSEMBLY NUMBER	DESCRIPTION	MODEL
05/13/80	BY [signature]	05/13/80	A	ASY-0112-00	CHASSIS	SEA 112

REF. DES.	PART NUMBER	DESCRIPTION & REMARKS	
C1	CAP-0036-001	CAPACITOR, ELECTROLTIC	1000uF
CR1	SEM-0089-001	DIODE	1N5402
F1	FUS-0004-025	FUSE	25 AMP
F2	FUS-0002-005	FUSE	5 AMP
FAB01	FAB-0106-05	PCB TRAY BOTTOM	
FAB03	FAB-0106-04	PCB TRAY TOP	
FAB07	FAB-1500-01	SIDE TRIM	
FAB08	FAB-1500-02	CASTINGS	
FAB09	FAB-1500-03	BACK PLATE	
FAB10	FAB-1500-04	SIDE PANEL	
FAB11	FAB-1500-05	PARTITION	
FH1	FUS-0003-001	FUSE HOLDER	
FH2	FUS-0001-001	FUSE HOLDER	
HAR1	HAR-0001-001	STAND OFF	
HAR4	HAR-0061-015	5 AMP STICKER	
J3	CON-0007-001	CONNECTOR UHF	
J4	CON-0007-001	CONNECTOR UHF	
J5	CON-0001-001	PHONO PLUG	
P2	CON-0005-001	CONNECTOR, POWER	
TR1	TER-0007-001	BARRIER STRIP	
TR2	TER-0015-001	TERMINAL STRIP	
TR3	TER-0022-001	JUMPER	

STEPHENS ENGINEERING ASSOCIATES, INC.
* * * P A R T S   L I S T * * *

ISSUED	APPROVED	REV DATE	REV	ASSEMBLY NUMBER	DESCRIPTION	MODEL
05/13/80	BY	05/13/80	A	ASY-0112-01	RF	SEA 112

REF. DES.	PART NUMBER	DESCRIPTION & REMARKS	
A 101	SEM-0101-001	AMPLIFIER	MC1350P
A 102	SEM-0101-001	AMPLIFIER	MC1350P
A 103	SEM-0102-001	ATTENUATOR	MC3340P
A 104	SEM-0105-001	AUDIO AMPLIFIER	TBA 810 AS
A 105	SEM-0102-001	ATTENUATOR	MC3340P
A 106	SEM-0103-001	BALANCED MODULATOR	TL 442 CN
A 107	MIX-0002-001	MIXER	MCL-SBL-1
A 108	MIX-0002-001	MIXER	MCL-SBL-1
C 101	CAP-0001-030	CAPACITOR MICA	360pf
C 102	CAP-0017-001	CAPACITOR DISC	.01uf
C 103	CAP-0016-001	CAPACITOR DISC	.luf
C 104	CAP-0016-001	CAPACITOR DISC	.luf
C 105	CAP-0016-001	CAPACITOR DISC	.luf
C 106	CAP-0016-001	CAPACITOR DISC	.luf
C 107	CAP-0017-001	CAPACITOR DISC	.01uf
C 108	CAP-0016-001	CAPACITOR DISC	.luf
C 109	CAP-0016-001	CAPACITOR DISC	.luf
C 110	CAP-0001-001	CAPACITOR MICA	10pf
C 111	CAP-0031-001	CAPACITOR TANTALUM	2.2uf 16V
C 112	CAP-0017-001	CAPACITOR DISC	.01uf
C 113	CAP-0018-001	CAPACITOR DISC	.05uf
C 114	CAP-0018-001	CAPACITOR DISC	.05uf
C 115	CAP-0012-001	CAPACITOR MYLAR	.luf
C 116	CAP-0016-001	CAPACITOR DISC	.luf
C 117	CAP-0016-001	CAPACITOR DISC	.luf
C 118	CAP-0016-001	CAPACITOR DISC	.luf
C 119	CAP-0016-001	CAPACITOR DISC	.luf
C 120	CAP-0016-001	CAPACITOR DISC	.luf
C 121	CAP-0017-001	CAPACITOR DISC	.01uf
C 122	CAP-0017-001	CAPACITOR DISC	.01uf
C 123	CAP-0016-001	CAPACITOR DISC	.luf
C 124	CAP-0016-001	CAPACITOR DISC	.luf
C 125	CAP-0031-007	CAPACITOR TANTALUM	22uf 16V
C 126	CAP-0017-001	CAPACITOR DISC	.01uf
C 127	CAP-0031-007	CAPACITOR TANTALUM	22uf 16V
C 128	CAP-0016-001	CAPACITOR DISC	.luf
C 129	CAP-0031-007	CAPACITOR TANTALUM	22uf 16V
C 130	CAP-0022-001	CAPACITOR DISC	.002uf
C 131	CAP-0016-001	CAPACITOR DISC	.luf
C 132	CAP-0030-009	CAPACITOR TANTALUM	22uf 25v
C 133	CAP-0034-005	CAPACITOR ELECT	220uf 16V
C 134	CAP-0000-002	ASSEMBLY	
C 135	CAP-0031-001	CAPACITOR TANTALUM	2.2uf 16V
C 136	CAP-0031-001	CAPACITOR TANTALUM	2.2uf 16V
C 137	CAP-0031-001	CAPACITOR TANTALUM	2.2uf 16V
C 138	CAP-0016-001	CAPACITOR DISC	.luf
C 139	CAP-0018-001	CAPACITOR DISC	.05uf
C 140	CAP-0017-001	CAPACITOR DISC	.01uf
C 141	CAP-0016-001	CAPACITOR DISC	.luf
C 142	CAP-0037-002	CAPACITOR ELECT	2.2uf 50v

STEPHENS ENGINEERING ASSOCIATES, INC.
* * * P A R T S   L I S T * * *

ISSUED	APPROVED	REV DATE	REV	ASSEMBLY NUMBER	DESCRIPTION	MODEL
05/13/80	BY PM	05/13/80	A	ASY-0112-01	RF	SEA 112

REF. DES.	PART NUMBER	DESCRIPTION & REMARKS	
C 143	CAP-0016-001	CAPACITOR DISC	.luf
C 144	CAP-0013-001	CAPACITOR MONOLYTHIC	.luf
C 145	CAP-0017-001	CAPACITOR DISC	.0luf
C 146	CAP-0018-001	CAPACITOR DISC	.05uf
C 147	CAP-0018-001	CAPACITOR DISC	.05uf
C 148	CAP-0018-001	CAPACITOR DISC	.05uf
C 149	CAP-0018-001	CAPACITOR DISC	.05uf
C 150	CAP-0018-001	CAPACITOR DISC	.05uf
C 151	CAP-0018-001	CAPACITOR DISC	.05uf
C 152	CAP-0016-001	CAPACITOR DISC	.luf
C 153	CAP-0018-001	CAPACITOR DISC	.05uf
C 154	CAP-0018-001	CAPACITOR DISC	.05uf
C 155	CAP-0001-018	CAPACITOR MICA	160pf
C 156	CAP-0001-021	CAPACITOR MICA	270pf
C 157	CAP-0001-020	CAPACITOR MICA	220pf
C 158	CAP-0000-000	NOT USED	
C 159	CAP-0018-001	CAPACITOR DISC	.05uf
C 160	CAP-0001-001	CAPACITOR MICA	10pf
C 161	CAP-0000-000	NOT USED	
C 162	CAP-0001-001	CAPACITOR MICA	10pf
C 163	CAP-0001-012	CAPACITOR MICA	68pf
C 164	CAP-0001-005	CAPACITOR MICA	30pf
C 165	CAP-0001-005	CAPACITOR MICA	30pf
C 166	CAP-0002-018	CAPACITOR CERAMIC	4.7pf
C 167	CAP-0002-018	CAPACITOR CERAMIC	4.7pf
C 168	CAP-0018-001	CAPACITOR DISC	.05uf
C 169	CAP-0018-001	CAPACITOR DISC	.05uf
C 170	CAP-0013-001	CAPACITOR MONOLYTHIC	.luf
C 171	CAP-0013-001	CAPACITOR MONOLYTHIC	.luf
C 172	CAP-0001-020	CAPACITOR MICA	220pf
C 173	CAP-0001-030	CAPACITOR MICA	360pf
C 174	CAP-0017-001	CAPACITOR DISC	.0luf
C 175	CAP-0017-001	CAPACITOR DISC	.0luf
C 176	CAP-0026-003	CAPACITOR FILM	.47uf
C 177	CAP-0021-001	CAPACITOR DISC	.00luf
C 178	CAP-0017-001	CAPACITOR DISC	.0luf
C 179	CAP-0016-001	CAPACITOR DISC	.luf
C 180	CAP-0017-001	CAPACITOR DISC	.0luf
C 181	CAP-0018-001	CAPACITOR DISC	.05uf
C 182	CAP-0018-001	CAPACITOR DISC	.05uf
C 183	CAP-0018-001	CAPACITOR DISC	.05uf
C 184	CAP-0016-001	CAPACITOR DISC	.luf
C 185	CAP-0001-005	CAPACITOR MICA	30pf
C 186	CAP-0001-002	CAPACITOR MICA	15pf
C 187	CAP-0001-002	CAPACITOR MICA	15pf
C 188	CAP-0002-018	CAPACITOR CERAMIC	4.7pf
C 189	CAP-0026-003	CAPACITOR FILM	.47uf
C 190	CAP-0017-001	CAPACITOR DISC	.0luf
C 191	CAP-0018-001	CAPACITOR DISC	.05uf
C 192	CAP-0001-020	CAPACITOR MICA	220pf

STEPHENS ENGINEERING ASSOCIATES, INC.
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ISSUED	APPROVED	REV DATE	REV	ASSEMBLY NUMBER	DESCRIPTION	MODEL
05/13/80	BY PM	05/13/80	A	ASY-0112-01	RF	SEA 112

REF. DES.	PART NUMBER	DESCRIPTION & REMARKS	
CR106	SEM-0076-001	DIODE	1N4148
CR107	SEM-0076-001	DIODE	1N4148
CR108	SEM-0076-001	DIODE	1N4148
CR109	SEM-0091-001	DIODE	1N3070
CR110	SEM-0076-001	DIODE	1N4148
CR111	SEM-0076-001	DIODE	1N4148
CR112	SEM-0092-001	DIODE, QUAD	
CR113	SEM-0092-001	DIODE, QUAD	
CR114	SEM-0076-001	DIODE	1N4148
CR115	SEM-0076-001	DIODE	1N4148
CR116	SEM-0076-001	DIODE	1N4148
CR117	SEM-0076-001	DIODE	1N4148
CR118	SEM-0076-001	DIODE	1N4148
CR119	SEM-0096-001	VARACTOR	KV2001
CR120	SEM-0096-001	VARACTOR	KV2001
CR121	SEM-0096-001	VARACTOR	KV2001
CR122	SEM-0076-001	DIODE	1N4148
CR123	SEM-0096-001	VARACTOR	KV2001
FL101	FIL-0004-001	FILTER MECHANICAL	455kHz
FL102	FIL-0008-001	FILTER ASSEMBLY	
H 101	HAR-0007-001	STANDOFF	1/8 X 4-40
H 102	HAR-0065-001	SPACER	1/8 X #4
H 103	HAR-0053-001	ENCLOSURE CAN	
H 104	HAR-0050-001	TRANSISTOR PAD	
HE101	FAB-0101-12	HEAT SINK, AUDIO AMP	
J 101	CON-0003-001	JACK, PHONO	
L 101	IND-0020-014	INDUCTOR	470uh
L 102	IND-0020-014	INDUCTOR	470uh
L 103	IND-0020-014	INDUCTOR	470uh
L 104	IND-0021-020	INDUCTOR	27uh
L 105	IND-0020-014	INDUCTOR	470uh
L 106	ASY-0004-08	ASSEMBLY, INDUCTOR	
L 107	IND-0001-129	INDUCTOR	1.2uh
L 108	IND-0001-129	INDUCTOR	1.2uh
L 109	ASY-0004-10	ASSEMBLY, INDUCTOR	
L 110	IND-0020-014	INDUCTOR	470uh
L 111	IND-0021-020	INDUCTOR	27uh
L 112	IND-0021-020	INDUCTOR	27uh
L 113	IND-0001-220	INDUCTOR	22 uH
L 114	IND-0020-014	INDUCTOR	470uh
L 115	IND-0020-014	INDUCTOR	470uh
L 116	IND-0021-020	INDUCTOR	27uh
L 117	IND-0021-020	INDUCTOR	27uh
L 118	IND-0021-020	INDUCTOR	27uh
L 119	IND-0021-020	INDUCTOR	27uh
L 120	IND-0021-020	INDUCTOR	27uh
L 121	IND-0001-470	INDUCTOR	47uh
L 122	ASY-0112-11	ASSEMBLY, INDUCTOR	
L 123	ASY-0004-08	ASSEMBLY, INDUCTOR	
L 124	ASY-0004-10	ASSEMBLY, INDUCTOR	

STEPHENS ENGINEERING ASSOCIATES, INC.
* * * P A R T S   L I S T * * *

ISSUED	APPROVED	REV DATE	REV	ASSEMBLY NUMBER	DESCRIPTION	MODEL
05/13/80	BY PM	05/13/80	A	ASY-0112-01	RF	SEA 112

REF. DES.	PART NUMBER	DESCRIPTION & REMARKS	
C 193	CAP-0021-001	CAPACITOR DISC	.001uf
C 194	CAP-0001-021	CAPACITOR MICA	270pf
C 195	CAP-0001-016	CAPACITOR MICA	130pf
C 196	CAP-0001-027	CAPACITOR MICA	620pf
C 197	CAP-0001-008	CAPACITOR MICA	47pf
C 198	CAP-0001-030	CAPACITOR MICA	360pf
C 199	CAP-0017-001	CAPACITOR DISC	.01uf
C1100	CAP-0018-001	CAPACITOR DISC	.05uf
C1101	CAP-0018-001	CAPACITOR DISC	.05uf
C1102	CAP-0017-001	CAPACITOR DISC	.01uf
C1103	CAP-0018-001	CAPACITOR DISC	.05uf
C1104	CAP-0001-002	CAPACITOR MICA	15pf
C1105	CAP-0018-001	CAPACITOR DISC	.05uf
C1106	CAP-0002-016	CAPACITOR CERAMIC	3.3pf
C1107	CAP-0001-005	CAPACITOR MICA	30pf
C1108	CAP-0001-005	CAPACITOR MICA	30pf
C1109	CAP-0025-001	CAPACITOR VARIABLE	2-20pf
C1110	CAP-0012-005	CAPACITOR MYLAR	.01uf
C1111	CAP-0001-008	CAPACITOR MICA	47pf
C1112	CAP-0016-001	CAPACITOR DISC	.1uf
C1113	CAP-0021-001	CAPACITOR DISC	.001uf
C1114	CAP-0001-005	CAPACITOR MICA	30pf
C1115	CAP-0018-001	CAPACITOR DISC	.05uf
C1116	CAP-0002-018	CAPACITOR CERAMIC	4.7pf
C1117	CAP-0001-002	CAPACITOR MICA	15pf
C1118	CAP-0018-001	CAPACITOR DISC	.05uf
C1119	CAP-0001-008	CAPACITOR MICA	47pf
C1120	CAP-0018-001	CAPACITOR DISC	.05uf
C1121	CAP-0018-001	CAPACITOR DISC	.05uf
C1122	CAP-0023-001	CAPACITOR TRIMMER	2-60pf
C1123	CAP-0037-002	CAPACITOR ELECT	2.2uf 50v
C1124	CAP-0000-000	NOT USED	
C1125	CAP-0017-001	CAPACITOR DISC	.01uf
C1126	CAP-0000-002	ASSEMBLY	
C1127	CAP-0000-000	NOT USED	
C1128	CAP-0000-000	NOT USED	
C1129	CAP-0025-001	CAPACITOR VARIABLE	2-20pf
C1130	CAP-0017-001	CAPACITOR DISC	.01uf
C1131	CAP-0018-001	CAPACITOR DISC	.05uf
C1132	CAP-0014-001	CAPACITOR DISC	.005uf
C1133	CAP-0034-005	CAPACITOR ELECT	220uf 16V
C1134	CAP-0017-001	CAPACITOR DISC	.01uf
C1135	CAP-0021-001	CAPACITOR DISC	.001uf
C1136	CAP-0000-001	FACTORY SELECT	
C1137	CAP-0017-001	CAPACITOR DISC	.01uf
CR101	SEM-0076-001	DIODE	1N4148
CR102	SEM-0076-001	DIODE	1N4148
CR103	SEM-0076-001	DIODE	1N4148
CR104	SEM-0076-001	DIODE	1N4148
CR105	SEM-0000-000	NOT USED	

STEPHENS ENGINEERING ASSOCIATES, INC.
* * * P A R T S L I S T * * *

ISSUED	APPROVED	REV DATE	REV	ASSEMBLY NUMBER	DESCRIPTION	MODEL
05/13/80	BY *PM*	05/13/80	A	ASY-0112-01	RF	SEA 112

REF. DES.	PART NUMBER	DESCRIPTION & REMARKS	
L 125	IND-0001-470	INDUCTOR	47uh
L 126	ASY-0112-10	ASSEMBLY, INDUCTOR	
L 127	IND-0001-101	INDUCTOR	100uh
L 128	IND-0021-020	INDUCTOR	27uh
L 129	IND-0021-020	INDUCTOR	27uh
PC101	PCB-0112-01	PRINTED CIRCUIT BOARD	
Q 101	SEM-0009-001	TRANSISTOR FET	U1898E
Q 102	SEM-0001-001	TRANSISTOR	2N3565
Q 103	SEM-0001-001	TRANSISTOR	2N3565
Q 104	SEM-0001-001	TRANSISTOR	2N3565
Q 105	SEM-0001-001	TRANSISTOR	2N3565
Q 106	SEM-0007-001	TRANSISTOR	2N3641
Q 107	SEM-0003-001	TRANSISTOR	2N3563
Q 108	SEM-0003-001	TRANSISTOR	2N3563
Q 109	SEM-0007-001	TRANSISTOR	2N3641
Q 110	SEM-0011-001	TRANSISTOR	2N918
Q 111	SEM-0016-001	TRANSISTOR	MPS-HO7
Q 112	SEM-0001-001	TRANSISTOR	2N3565
Q 113	SEM-0009-001	TRANSISTOR FET	U1898E
Q 114	SEM-0017-001	TRANSISTOR FET	3N212 GRADED
Q 115	SEM-0003-001	TRANSISTOR	2N3563
Q 116	SEM-0007-001	TRANSISTOR	2N3641
Q 117	SEM-0003-001	TRANSISTOR	2N3563
Q 118	SEM-0007-001	TRANSISTOR	2N3641
Q 119	SEM-0007-001	TRANSISTOR	2N3641
Q 120	SEM-0011-001	TRANSISTOR	2N918
Q 121	SEM-0001-001	TRANSISTOR	2N3565
Q 122	SEM-0007-001	TRANSISTOR	2N3641
R 101	RES-0001-472	RESISTOR	4.7K
R 102	RES-0001-103	RESISTOR	10K
R 103	RES-0001-471	RESISTOR	470
R 104	RES-0001-103	RESISTOR	10K
R 105	RES-0001-223	RESISTOR	22K
R 106	RES-0001-104	RESISTOR	100K
R 107	RES-0001-104	RESISTOR	100K
R 108	RES-0001-103	RESISTOR	10K
R 109	RES-0001-106	RESISTOR	10M
R 110	RES-0025-502	RESISTOR VARIABLE	5K
R 111	RES-0001-103	RESISTOR	10K
R 112	RES-0001-681	RESISTOR	680
R 113	RES-0001-122	RESISTOR	1.2K
R 114	RES-0001-123	RESISTOR	12K
R 115	RES-0001-222	RESISTOR	2.2K
R 116	RES-0001-821	RESISTOR	820
R 117	RES-0001-222	RESISTOR	2.2K
R 118	RES-0001-472	RESISTOR	4.7K
R 119	RES-0001-560	RESISTOR	56
R 120	RES-0001-101	RESISTOR	100
R 121	RES-0001-103	RESISTOR	10K
R 122	RES-0001-012	RESISTOR	1.2

STEPHENS ENGINEERING ASSOCIATES, INC.
* * * P A R T S   L I S T * * *

ISSUED	APPROVED	REV DATE	REV	ASSEMBLY NUMBER	DESCRIPTION	MODEL
05/13/80	BY JM	05/13/80	A	ASY-0112-01	RF	SEA 112

REF. DES.	PART NUMBER	DESCRIPTION & REMARKS	
R 123	RES-0001-472	RESISTOR	4.7K
R 124	RES-0001-271	RESISTOR	270
R 125	RES-0001-223	RESISTOR	22K
R 126	RES-0001-471	RESISTOR	470
R 127	RES-0001-222	RESISTOR	2.2K
R 128	RES-0025-104	RESISTOR VARIABLE	100K
R 129	RES-0001-472	RESISTOR	4.7K
R 130	RES-0000-000	NOT USED	
R 131	RES-0000-000	NOT USED	
R 132	RES-0001-100	RESISTOR	10
R 133	RES-0001-103	RESISTOR	10K
R 134	RES-0001-472	RESISTOR	4.7K
R 135	RES-0000-000	NOT USED	
R 136	RES-0001-101	RESISTOR	100
R 137	RES-0001-101	RESISTOR	100
R 138	RES-0001-270	RESISTOR	27
R 139	RES-0001-222	RESISTOR	2.2K
R 140	RES-0001-471	RESISTOR	470
R 141	RES-0001-271	RESISTOR	270
R 142	RES-0001-102	RESISTOR	1K
R 143	RES-0001-101	RESISTOR	100
R 144	RES-0001-221	RESISTOR	220
R 145	RES-0027-101	RESISTOR VARIABLE	100
R 146	RES-0001-221	RESISTOR	220
R 147	RES-0001-103	RESISTOR	10K
R 148	RES-0001-682	RESISTOR	6.8K
R 149	RES-0001-333	RESISTOR	33K
R 150	RES-0001-471	RESISTOR	470
R 151	RES-0001-821	RESISTOR	820
R 152	RES-0001-151	RESISTOR	150
R 153	RES-0001-103	RESISTOR	10K
R 154	RES-0001-332	RESISTOR	3.3K
R 155	RES-0001-473	RESISTOR	47K
R 156	RES-0001-470	RESISTOR	47
R 157	RES-0001-151	RESISTOR	150
R 158	RES-0001-821	RESISTOR	820
R 159	RES-0001-102	RESISTOR	1K
R 160	RES-0025-501	RESISTOR VARIABLE	500
R 161	RES-0025-501	RESISTOR VARIABLE	500
R 162	RES-0001-473	RESISTOR	47K
R 163	RES-0001-473	RESISTOR	47K
R 164	RES-0000-000	NOT USED	
R 165	RES-0001-104	RESISTOR	100K
R 166	RES-0001-151	RESISTOR	150
R 167	RES-0001-473	RESISTOR	47K
R 168	RES-0001-103	RESISTOR	10K
R 169	RES-0001-472	RESISTOR	4.7K
R 170	RES-0001-101	RESISTOR	100
R 171	RES-0001-150	RESISTOR	15
R 172	RES-0001-471	RESISTOR	470

STEPHENS ENGINEERING ASSOCIATES, INC.
* * * P A R T S   L I S T * * *

ISSUED	APPROVED	REV DATE	REV	ASSEMBLY NUMBER	DESCRIPTION	MODEL
05/13/80	BY BM	05/13/80	A	ASY-0112-01	RF	SEA 112

REF. DES.	PART NUMBER	DESCRIPTION & REMARKS	
R 173	RES-0001-222	RESISTOR	2.2K
R 174	RES-0001-101	RESISTOR	100
R 175	RES-0001-103	RESISTOR	10K
R 176	RES-0001-222	RESISTOR	2.2K
R 177	RES-0001-330	RESISTOR	33
R 178	RES-0001-101	RESISTOR	100
R 179	RES-0001-471	RESISTOR	470
R 180	RES-0001-330	RESISTOR	33
R 181	RES-0001-102	RESISTOR	1K
R 182	RES-0000-000	NOT USED	
R 183	RES-0001-271	RESISTOR	270
R 184	RES-0000-000	NOT USED	
R 185	RES-0001-680	RESISTOR	68
R 186	RES-0001-151	RESISTOR	150
R 187	RES-0001-472	RESISTOR	4.7K
R 188	RES-0001-103	RESISTOR	10K
R 189	RES-0001-151	RESISTOR	150
R 190	RES-0001-103	RESISTOR	10K
R 191	RES-0001-472	RESISTOR	4.7K
R 192	RES-0001-103	RESISTOR	10K
R 193	RES-0001-472	RESISTOR	4.7K
R 194	RES-0001-222	RESISTOR	2.2K
R 195	RES-0001-471	RESISTOR	470
R 196	RES-0001-472	RESISTOR	4.7K
R 197	RES-0001-103	RESISTOR	10K
R 198	RES-0001-104	RESISTOR	100K
R 199	RES-0001-222	RESISTOR	2.2K
R1100	RES-0001-470	RESISTOR	47
R1101	RES-0001-470	RESISTOR	47
R1102	RES-0001-221	RESISTOR	220
R1103	RES-0001-473	RESISTOR	47K
R1104	RES-0001-221	RESISTOR	220
R1105	RES-0001-332	RESISTOR	3.3K
S 101	SWI-0008-001	SWITCH DPDT	
T 101	TRA-0008-001	TRANSFORMER	IF (BLK)
T 102	TRA-0008-001	TRANSFORMER	IF (BLK)
T 103	TRA-0004-002	TRANSFORMER	AUDIO
T 104	ASY-0101-05A	TRANSFORMER	BROADBAND
T 105	TRA-0013-001	TRANSFORMER	IF (GRN)
T 106	TRA-0013-001	TRANSFORMER	IF (GRN)
T 107	TRA-0011-001	TRANSFORMER	IF (VIO)
T 108	TRA-0008-001	TRANSFORMER	IF (BLK)
T 109	ASY-0035-05A	TRANSFORMER	BROADBAND
T 110	ASY-0101-05A	TRANSFORMER	BROADBAND
T 111	ASY-0101-05A	TRANSFORMER	BROADBAND
T 112	TRA-0013-001	TRANSFORMER	IF (GRN)
T 113	ASY-0010-08	ASSEMBLY, TRANSFORMER	
T 114	TRA-0011-001	TRANSFORMER	IF (VIO)
TR101	TER-0004-001	TERMINAL	STAKE
Y 101	CRY-0006-004	CRYSTAL	21.855Mhz

STEPHENS ENGINEERING ASSOCIATES, INC.
* * * P A R T S   L I S T * * *

ISSUED	APPROVED	REV DATE	REV	ASSEMBLY NUMBER	DESCRIPTION	MODEL
05/13/80	BY JM	05/13/80	A	ASY-0112-01	RF	SEA 112

REF. DES.	PART NUMBER	DESCRIPTION & REMARKS	
Y 102	CRY-0008-001	CRYSTAL	22.5Mhz

STEPHENS ENGINEERING ASSOCIATES, INC.
* * * P A R T S   L I S T * * *

ISSUED	APPROVED	REV DATE	REV	ASSEMBLY NUMBER	DESCRIPTION	MODEL
05/13/80	BY [signature]	02/26/80	A	ASY-0112-02	COUNTER	SEA 112

REF. DES.	PART NUMBER	DESCRIPTION & REMARKS	
C228	CAP-0016-001	CAPACITOR DISC	.luf
C229	CAP-0034-005	CAPACITOR ELECT	220uf 16V
C230	CAP-0031-007	CAPACITOR TANTALUM	22uf 16V
C231	CAP-0016-001	CAPACITOR DISC	.luf
C232	CAP-0016-001	CAPACITOR DISC	.luf
C233	CAP-0016-001	CAPACITOR DISC	.luf
C234	CAP-0016-001	CAPACITOR DISC	.luf
C235	CAP-0016-001	CAPACITOR DISC	.luf
C236	CAP-0016-001	CAPACITOR DISC	.luf
C237	CAP-0016-001	CAPACITOR DISC	.luf
C238	CAP-0031-001	CAPACITOR TANTALUM	2.2uf 16V
C239	CAP-0031-001	CAPACITOR TANTALUM	2.2uf 16V
C240	CAP-0031-001	CAPACITOR TANTALUM	2.2uf 16V
C241	CAP-0031-001	CAPACITOR TANTALUM	2.2uf 16V
C242	CAP-0001-008	CAPACITOR MICA	47pf
C243	CAP-0021-001	CAPACITOR DISC	.001uf
C244	CAP-0016-001	CAPACITOR DISC	.luf
C245	CAP-0026-004	CAPACITOR FILM	luf
C246	CAP-0013-001	CAPACITOR MONOLYTHIC	.luf
C247	CAP-0021-001	CAPACITOR DISC	.001uf
CR201	SEM-0083-002	DIODE, ZENER	1N4741
CR202	SEM-0076-001	DIODE	1N4148
HE201	HEA-0005-001	HEAT SINK	
HE202	HEA-0005-002	HEAT SINK	
J201	CON-0003-001	JACK, PHONO	
J202	CON-0003-001	JACK, PHONO	
J203	CON-0003-001	JACK, PHONO	
J204	CON-0003-001	JACK, PHONO	
J205	CON-0003-001	JACK, PHONO	
J206	SOC-0004-024	24 PIN SOCKET	
J207	SOC-0002-003	20 PIN SOCKET	
J208	SOC-0002-003	20 PIN SOCKET	
J209	SOC-0002-003	20 PIN SOCKET	
J210	SOC-0002-002	16 PIN SOCKET	
L201	IND-0020-015	INDUCTOR	1500 uH
OV201	OVE-0005-001	CRYSTAL OVEN	
PC201	PCB-0112-02	PRINTED CIRCUIT BOARD	
Q201	SEM-0021-001	TRANSISTOR	2N2222
Q202	SEM-0021-001	TRANSISTOR	2N2222
Q203	SEM-0021-001	TRANSISTOR	2N2222
Q204	SEM-0021-001	TRANSISTOR	2N2222
Q205	SEM-0021-001	TRANSISTOR	2N2222
Q206	SEM-0001-001	TRANSISTOR	2N3565
Q207	SEM-0001-001	TRANSISTOR	2N3565
Q208	SEM-0001-001	TRANSISTOR	2N3565
Q209	SEM-0010-001	TRANSISTOR	MPS-A14
Q210	SEM-0026-001	TRANSISTOR	TIP-120
Q211	SEM-0021-001	TRANSISTOR	2N2222
Q212	SEM-0026-001	TRANSISTOR	TIP-120
Q213	SEM-0021-001	TRANSISTOR	2N2222

STEPHENS ENGINEERING ASSOCIATES, INC.
* * * P A R T S   L I S T * * *

ISSUED	APPROVED	REV DATE	REV	ASSEMBLY NUMBER	DESCRIPTION	MODEL
05/13/80	BY Dm	02/26/80	A	ASY-0112-02	COUNTER	SEA 112

REF. DES.	PART NUMBER	DESCRIPTION & REMARKS	
A201	SEM-0112-001	IC	74C00
A202	SEM-0129-001	IC	74LS90
A203	SEM-0113-002	IC	74LS74
A204	SEM-0114-002	IC	74LS192
A205	SEM-0114-002	IC	74LS192
A206	SEM-0130-001	IC	74LS390
A207	SEM-0121-001	IC	4046
A208	SEM-0121-001	IC	4046
A209	SEM-0107-001	IC	74C85
A210	SEM-0131-001	IC	74LS04
A211	SEM-0132-001	IC	74LS30
A212	SEM-0113-002	IC	74LS74
A213	SEM-0116-001	IC	74LS13
A214	SEM-0123-001	IC	MC14522B
A215	SEM-0123-001	IC	MC14522B
A216	SEM-0123-001	IC	MC14522B
A217	SEM-0114-002	IC	74LS192
A218	SEM-0114-002	IC	74LS192
A219	SEM-0114-002	IC	74LS192
A220	SEM-0114-002	IC	74LS192
A221	SEM-0133-001	IC	7401
A222	SEM-0109-001	+5V REGULATOR	7805
A223	SEM-0109-001	+5V REGULATOR	7805
C201	CAP-0001-015	CAPACITOR MICA	100pf
C202	CAP-0001-003	CAPACITOR MICA	22pf
C203	CAP-0001-004	CAPACITOR MICA	27 pf
C204	CAP-0025-002	CAPACITOR VARIABLE	2-12pf
C205	CAP-0016-001	CAPACITOR DISC	.1uf
C206	CAP-0016-001	CAPACITOR DISC	.1uf
C207	CAP-0016-001	CAPACITOR DISC	.1uf
C208	CAP-0016-001	CAPACITOR DISC	.1uf
C209	CAP-0016-001	CAPACITOR DISC	.1uf
C210	CAP-0016-001	CAPACITOR DISC	.1uf
C211	CAP-0016-001	CAPACITOR DISC	.1uf
C212	CAP-0026-005	CAPACITOR FILM	.22 uf
C213	CAP-0026-004	CAPACITOR FILM	1uf
C214	CAP-0016-001	CAPACITOR DISC	.1uf
C215	CAP-0026-003	CAPACITOR FILM	.47uf
C216	CAP-0026-004	CAPACITOR FILM	1uf
C217	CAP-0017-001	CAPACITOR DISC	.01uf
C218	CAP-0017-001	CAPACITOR DISC	.01uf
C219	CAP-0016-001	CAPACITOR DISC	.1uf
C220	CAP-0014-001	CAPACITOR DISC	.005uf
C221	CAP-0021-001	CAPACITOR DISC	.001uf
C222	CAP-0016-001	CAPACITOR DISC	.1uf
C223	CAP-0031-001	CAPACITOR TANTALUM	2.2uf 16V
C224	CAP-0012-003	CAPACITOR, MYLAR	.0015uF
C225	CAP-0017-001	CAPACITOR DISC	.01uf
C226	CAP-0017-001	CAPACITOR DISC	.01uf
C227	CAP-0016-001	CAPACITOR DISC	.1uf

STEPHENS ENGINEERING ASSOCIATES, INC.
* * * P A R T S   L I S T * * *

ISSUED	APPROVED	REV DATE	REV	ASSEMBLY NUMBER	DESCRIPTION	MODEL
05/13/80	BY Bm	03/13/80	A	ASY-0112-14	SQUELCH	SEA 112

REF. DES.	PART NUMBER	DESCRIPTION & REMARKS	
A 1	SEM-0134-001	OP AMP	4136
A 2	SEM-0134-001	OP AMP	4136
C 1	CAP-0017-001	CAPACITOR DISC	.01uf
C 2	CAP-0021-001	CAPACITOR DISC	.001uf
C 3	CAP-0013-001	CAPACITOR MONOLYTHIC	.1uf
C 4	CAP-0013-001	CAPACITOR MONOLYTHIC	.1uf
C 5	CAP-0031-003	CAPACITOR TANTALUM	4.7uf 16V
C 6	CAP-0013-002	CAPACITOR MONOLYTHIC	.22uf
C 7	CAP-0031-007	CAPACITOR TANTALUM	22uf 16V
C 8	CAP-0031-007	CAPACITOR TANTALUM	22uf 16V
C 9	CAP-0031-007	CAPACITOR TANTALUM	22uf 16V
C10	CAP-0017-001	CAPACITOR DISC	.01uf
C11	CAP-0016-001	CAPACITOR DISC	.1uf
C12	CAP-0031-003	CAPACITOR TANTALUM	4.7uf 16V
C13	CAP-0031-007	CAPACITOR TANTALUM	22uf 16V
C14	CAP-0017-001	CAPACITOR DISC	.01uf
C15	CAP-0031-007	CAPACITOR TANTALUM	22uf 16V
CR 1	SEM-0076-001	DIODE	1N4148
CR 2	SEM-0076-001	DIODE	1N4148
CR 3	SEM-0076-001	DIODE	1N4148
CR 4	SEM-0076-001	DIODE	1N4148
CR 5	SEM-0076-001	DIODE	1N4148
PCB 1	PCB-0101-12	PRINTED CIRCUIT BOARD	
R 1	RES-0001-472	RESISTOR	4.7K
R 2	RES-0001-474	RESISTOR	470K
R 3	RES-0001-470	RESISTOR	47
R 4	RES-0001-474	RESISTOR	470K
R 5	RES-0001-472	RESISTOR	4.7K
R 6	RES-0001-473	RESISTOR	47K
R 7	RES-0001-103	RESISTOR	10K
R 8	RES-0001-473	RESISTOR	47K
R 9	RES-0001-473	RESISTOR	47K
R10	RES-0001-472	RESISTOR	4.7K
R11	RES-0001-102	RESISTOR	1K
R12	RES-0001-102	RESISTOR	1K
R13	RES-0001-822	RESISTOR	8.2K
R14	RES-0001-104	RESISTOR	100K
R15	RES-0001-681	RESISTOR	680
R16	RES-0001-104	RESISTOR	100K
R17	RES-0001-184	RESISTOR	180K
R18	RES-0001-272	RESISTOR	2.7K
R19	RES-0001-104	RESISTOR	100K
R20	RES-0001-822	RESISTOR	8.2K
R21	RES-0001-104	RESISTOR	100K
R22	RES-0001-274	RESISTOR	270K
R23	RES-0001-104	RESISTOR	100K
R24	RES-0001-223	RESISTOR	22K
R25	RES-0001-184	RESISTOR	180K
R26	RES-0025-501	RESISTOR VARIABLE	500
R27	RES-0001-102	RESISTOR	1K

STEPHENS ENGINEERING ASSOCIATES, INC.

* * * P A R T S L I S T * * *

ISSUED	APPROVED	REV DATE	REV	ASSEMBLY NUMBER	DESCRIPTION	MODEL
05/13/80	BY Dy	03/13/80	A	ASY-0112-14	SQUELCH	SEA 112

REF. DES.	PART NUMBER	DESCRIPTION & REMARKS	
R28	RES-0001-102	RESISTOR	1K
R29	RES-0001-103	RESISTOR	10K
R30	RES-0001-103	RESISTOR	10K
R31	RES-0001-272	RESISTOR	2.7K
R32	RES-0001-103	RESISTOR	10K
R33	RES-0001-102	RESISTOR	1K
TER 1	TER-0004-001	TERMINAL	STAKE

STEPHENS ENGINEERING ASSOCIATES, INC.
* * * P A R T S   L I S T * * *

ISSUED	APPROVED	REV DATE	REV	ASSEMBLY NUMBER	DESCRIPTION	MODEL
05/13/80	BY DM	03/13/80	A	ASY-0112-13	PIN DIODE	SEA 112

REF. DES.	PART NUMBER	DESCRIPTION & REMARKS	
C1	CAP-0026-001	CAPACITOR FILM	.luf
C2	CAP-0026-001	CAPACITOR FILM	.luf
CR1	SEM-0076-001	DIODE	1N4148
CR2	SEM-0076-001	DIODE	1N4148
CR3	SEM-0076-001	DIODE	1N4148
CR4	SEM-0076-001	DIODE	1N4148
CR5	SEM-0076-001	DIODE	1N4148
CR6	SEM-0076-001	DIODE	1N4148
CR7	SEM-0096-002	DIODE	KS1001
CR8	SEM-0096-002	DIODE	KS1001
E1	EYE-0001-001	EYELET	
EN1	HAR-0053-001	ENCLOSURE CAN	
L1	IND-0008-003	INDUCTOR	.47uH
P1	CON-0001-001	PHONO PLUG	
PC1	PCB-0101-13	PRINTED CIRCUIT BOARD	
ST1	HAR-0057-001	SWAGE	6-32 x 1/8"
TER1	TER-0010-002	TERMINAL	

STEPHENS ENGINEERING ASSOCIATES, INC.
* * * P A R T S   L I S T * * *

ISSUED	APPROVED	REV DATE	REV	ASSEMBLY NUMBER	DESCRIPTION	MODEL
05/13/80	BY ~~MH~~	05/13/80	A	ASY-0112-09	FILTER	SEA 112

REF. DES.	PART NUMBER	DESCRIPTION & REMARKS	
ST901	HAR-0008-001	STAND OFF	4124
TR901	TER-0004-001	TERMINAL	STAKE

STEPHENS ENGINEERING ASSOCIATES, INC.

* * * P A R T S   L I S T * * *

ISSUED	APPROVED	REV DATE	REV	ASSEMBLY NUMBER	DESCRIPTION	MODEL
05/13/80	BY [signature]	05/13/80	A	ASY-0112-09	FILTER	SEA 112

REF. DES.	PART NUMBER	DESCRIPTION & REMARKS	
C 901	CAP-0016-001	CAPACITOR DISC	.luf
C 902	CAP-0016-001	CAPACITOR DISC	.luf
C 903	CAP-0034-005	CAPACITOR ELECT	220uf 16V
C 904	CAP-0034-005	CAPACITOR ELECT	220uf 16V
C 905	CAP-0016-001	CAPACITOR DISC	.luf
C 906	CAP-0003-007	CAPACITOR DM19	1200pf
C 907	CAP-0003-029	CAPACITOR DM19	120pf
C 908	CAP-0003-006	CAPACITOR DM19	1000pf
C 909	CAP-0003-014	CAPACITOR DM19	620pf
C 910	CAP-0003-025	CAPACITOR DM19	560pf
C 911	CAP-0003-006	CAPACITOR DM19	1000pf
C 912	CAP-0003-004	CAPACITOR DM19	470pf
C 913	CAP-0003-022	CAPACITOR DM19	360pf
C 914	CAP-0003-006	CAPACITOR DM19	1000pf
C 915	CAP-0003-025	CAPACITOR DM19	560pf
C 916	CAP-0003-026	CAPACITOR DM19	75pf
C 917	CAP-0003-017	CAPACITOR DM19	750pf
C 918	CAP-0003-022	CAPACITOR DM19	360pf
C 919	CAP-0003-005	CAPACITOR DM19	680pf
C 920	CAP-0003-018	CAPACITOR DM19	250pf
C 921	CAP-0003-024	CAPACITOR DM19	430pf
C 922	CAP-0003-019	CAPACITOR DM19	270pf
C 923	CAP-0003-027	CAPACITOR DM19	50pf
C 924	CAP-0003-003	CAPACITOR DM19	330pf
C 925	CAP-0003-002	CAPACITOR DM19	220pf
C 926	CAP-0003-028	CAPACITOR DM19	300pf
C 927	CAP-0003-001	CAPACITOR DM19	100pf
C 928	CAP-0003-013	CAPACITOR DM19	150pf
CR901	SEM-0083-001	DIODE	1N4740A
CR902	SEM-0076-001	DIODE	1N4148
CR903	SEM-0076-001	DIODE	1N4148
H 901	FAB-0106-03	FILTER BRACKET	
H 902	HAR-0600-004	LUG, GROUND	#6
HE901	HEA-0002-001	HEAT SINK	TIP 120
J 901	CON-0009-001	CONNECTOR, ANT COUP	
K 901	REL-0003-001	RELAY	
L 901	ASY-0003-21	INDUCTOR, TOROID	
L 902	ASY-0003-18	INDUCTOR, TOROID	
L 903	ASY-0003-19	INDUCTOR, TOROID	
L 904	ASY-0003-12	INDUCTOR, TOROID	
L 905	ASY-0003-11	INDUCTOR, TOROID	
L 906	ASY-0003-12	INDUCTOR, TOROID	
L 907	ASY-0003-08	INDUCTOR, TOROID	
L 908	ASY-0003-07	INDUCTOR, TOROID	
L 909	ASY-0003-09	INDUCTOR, TOROID	
PC901	PCB-0112-09	PRINTED CIRCUIT BOARD	
Q 901	SEM-0026-001	TRANSISTOR	TIP-120
R 901	RES-0001-102	RESISTOR	1K
R 902	RES-0001-471	RESISTOR	470
S 901	SWI-0005-001	RF SWITCH	

STEPHENS ENGINEERING ASSOCIATES, INC.
* * * P A R T S   L I S T * * *

ISSUED	APPROVED	REV DATE	REV	ASSEMBLY NUMBER	DESCRIPTION	MODEL
05/13/80	BY	05/13/80	A	ASY-0112-07	L.C.D.	SEA 112

REF. DES.	PART NUMBER	DESCRIPTION & REMARKS	
A700	SEM-0136-001	IC	4047
A701	SEM-0137-001	IC	4030
A702	SEM-0138-001	IC	4055
A703	SEM-0138-001	IC	4055
A704	SEM-0138-001	IC	4055
A705	SEM-0138-001	IC	4055
A706	SEM-0138-001	IC	4055
A707	SEM-0120-001	IC	MC14560B
C701	CAP-0012-007	CAPACITOR MYLAR	.022uf
C702	CAP-0037-001	CAPACITOR ELECT	22uf 35V
C703	CAP-0013-001	CAPACITOR MONOLYTHIC	.1uf
C704	CAP-0013-001	CAPACITOR MONOLYTHIC	.1uf
CR701	SEM-0076-001	DIODE	1N4148
CR702	SEM-0076-001	DIODE	1N4148
D701	DIS-0001-001	L.C.D.	FEO 401
FB701	FAB-0112-02	BEZEL, L.C.D.	
LS1	SPE-0001-002	SPEAKER, REMOTE	
P701	CON-0014-024	24 PIN CONNECTOR	
P702	CON-0014-024	24 PIN CONNECTOR	
PC701	PCB-0112-07	PRINTED CIRCUIT BOARD	L.C.D.
R701	RES-0001-224	RESISTOR	220K
R702	RES-0001-103	RESISTOR	10K

STEPHENS ENGINEERING ASSOCIATES, INC.

* * * P A R T S L I S T * * *

ISSUED	APPROVED	REV DATE	REV	ASSEMBLY NUMBER	DESCRIPTION	MODEL
05/13/80	BY PM	03/13/80	B	ASY-0112-06	INTERFACE	SEA 112

REF. DES.	PART NUMBER	DESCRIPTION & REMARKS	
A601	SEM-0135-001	PROM (PROGRAMMED)	74S188
CR601	SEM-0076-001	DIODE	1N4148
CR602	SEM-0076-001	DIODE	1N4148
CR603	SEM-0076-001	DIODE	1N4148
CR604	SEM-0076-001	DIODE	1N4148
CR605	SEM-0076-001	DIODE	1N4148
CR606	SEM-0076-001	DIODE	1N4148
CR607	SEM-0076-001	DIODE	1N4148
CR608	SEM-0076-001	DIODE	1N4148
CR609	SEM-0076-001	DIODE	1N4148
CR610	SEM-0076-001	DIODE	1N4148
CR611	SEM-0076-001	DIODE	1N4148
CR612	SEM-0076-001	DIODE	1N4148
CR613	SEM-0076-001	DIODE	1N4148
CR614	SEM-0076-001	DIODE	1N4148
CR615	SEM-0076-001	DIODE	1N4148
CR616	SEM-0076-001	DIODE	1N4148
CR617	SEM-0076-001	DIODE	1N4148
CR618	SEM-0076-001	DIODE	1N4148
CR619	SEM-0076-001	DIODE	1N4148
CR620	SEM-0076-001	DIODE	1N4148
CR621	SEM-0076-001	DIODE	1N4148
CR622	SEM-0076-001	DIODE	1N4148
CR623	SEM-0076-001	DIODE	1N4148
CR624	SEM-0076-001	DIODE	1N4148
CR625	SEM-0076-001	DIODE	1N4148
CR626	SEM-0076-001	DIODE	1N4148
CR627	SEM-0076-001	DIODE	1N4148
PC1	PCB-0112-06	PRINTED CIRCUIT BOARD	
Q601	SEM-0004-001	TRANSISTOR	2N5142
Q602	SEM-0004-001	TRANSISTOR	2N5142
Q603	SEM-0004-001	TRANSISTOR	2N5142
Q604	SEM-0004-001	TRANSISTOR	2N5142
Q605	SEM-0004-001	TRANSISTOR	2N5142
Q606	SEM-0004-001	TRANSISTOR	2N5142
Q607	SEM-0004-001	TRANSISTOR	2N5142
Q608	SEM-0004-001	TRANSISTOR	2N5142
R601	RES-0001-122	RESISTOR	1.2K
R602	RES-0001-122	RESISTOR	1.2K
R603	RES-0001-122	RESISTOR	1.2K
R604	RES-0001-122	RESISTOR	1.2K
R605	RES-0001-103	RESISTOR	10K
R606	RES-0001-103	RESISTOR	10K
R607	RES-0001-103	RESISTOR	10K
R608	RES-0001-103	RESISTOR	10K
R609	RES-0001-103	RESISTOR	10K
R610	RES-0001-103	RESISTOR	10K
R611	RES-0001-103	RESISTOR	10K
R612	RES-0001-103	RESISTOR	10K
R613	RES-0028-102	RESISTOR NETWORK	1K

STEPHENS ENGINEERING ASSOCIATES, INC.
* * * P A R T S   L I S T * * *

ISSUED	APPROVED	REV DATE	REV	ASSEMBLY NUMBER	DESCRIPTION	MODEL
05/13/80	BY PM	03/13/80	B	ASY-0112-06	INTERFACE	SEA 112

REF. DES.	PART NUMBER	DESCRIPTION & REMARKS	
S601	SWI-0013-001	SWITCH DIP	6 SECTION
S602	SWI-0013-001	SWITCH DIP	6 SECTION
S603	SWI-0013-001	SWITCH DIP	6 SECTION
S604	SWI-0013-001	SWITCH DIP	6 SECTION
SO601	SOC-0002-002	16 PIN SOCKET	
TR1	TER-0004-001	TERMINAL	STAKE

STEPHENS ENGINEERING ASSOCIATES, INC.
* * * P A R T S   L I S T * * *

ISSUED	APPROVED	REV DATE	REV	ASSEMBLY NUMBER	DESCRIPTION	MODEL
05/13/80	BY [signature]	05/13/80	D	ASY-0112-03	POWER AMP	SEA 112

REF. DES.	PART NUMBER	DESCRIPTION & REMARKS	
C301	CAP-0031-005	CAPACITOR TANTALUM	10uf 16V
C302	CAP-0016-001	CAPACITOR DISC	.1uf
C303	CAP-0016-001	CAPACITOR DISC	.1uf
C304	CAP-0031-005	CAPACITOR TANTALUM	10uf 16V
C305	CAP-0000-000	NOT USED	
C306	CAP-0017-001	CAPACITOR DISC	.01uf
C307	CAP-0017-001	CAPACITOR DISC	.01uf
C308	CAP-0016-001	CAPACITOR DISC	.1uf
C309	CAP-0016-001	CAPACITOR DISC	.1uf
C310	CAP-0016-001	CAPACITOR DISC	.1uf
C311	CAP-0031-007	CAPACITOR TANTALUM	22uf 16V
C312	CAP-0031-007	CAPACITOR TANTALUM	22uf 16V
C314	CAP-0013-001	CAPACITOR MONOLYTHIC	.1uf
C315	CAP-0013-001	CAPACITOR MONOLYTHIC	.1uf
C316	CAP-0013-001	CAPACITOR MONOLYTHIC	.1uf
C317	CAP-0013-001	CAPACITOR MONOLYTHIC	.1uf
C318	CAP-0016-001	CAPACITOR DISC	.1uf
C319	CAP-0016-001	CAPACITOR DISC	.1uf
C320	CAP-0016-001	CAPACITOR DISC	.1uf
C321	CAP-0030-003	CAPACITOR TANTALUM	2.2uf 16V
C322	CAP-0016-001	CAPACITOR DISC	.1uf
C323	CAP-0016-001	CAPACITOR DISC	.1uf
C324	CAP-0031-005	CAPACITOR TANTALUM	10uf 16V
C325	CAP-0016-001	CAPACITOR DISC	.1uf
C326	CAP-0016-001	CAPACITOR DISC	.1uf
C327	CAP-0016-001	CAPACITOR DISC	.1uf
C328	CAP-0032-001	CAPACITOR TANTALUM	22uf 35V
C329	CAP-0032-001	CAPACITOR TANTALUM	22uf 35V
C330	CAP-0003-020	CAPACITOR DM19	820pf
CR301	SEM-0087-001	DIODE	1N4004
CR302	SEM-0083-001	DIODE	1N4740A
CR303	SEM-0076-001	DIODE	1N4148
CR304	SEM-0076-001	DIODE	1N4148
FE301	FER-0004-001	TOROID BEAD	
HE301	FAB-1500-10	HEAT SINK, PA	
HE302	HEA-0003-001	HEAT SINK	
J301	CON-0004-001	JACK PHONO	
J302	CON-0002-001	JACK PHONO	
L301	IND-0001-129	INDUCTOR	1.2uh
PA301	HAR-0029-001	TRANSISTOR PAD	
PC301	PCB-0101-03	PRINTED CIRCUIT BOARD	
Q301	SEM-0063-001	TRANSISTOR	2N3866
Q302	SEM-0057-001	TRANSISTOR	RF2092
Q303	SEM-0066-002	TRANSISTOR	SD1487
Q304	SEM-0066-002	TRANSISTOR	SD1487
Q305	SEM-0032-001	TRANSISTOR	TIP-31
Q306	SEM-0001-001	TRANSISTOR	2N3565
Q307	SEM-0026-001	TRANSISTOR	TIP-120
R301	RES-0001-820	RESISTOR	82
R302	RES-0001-330	RESISTOR	33

STEPHENS ENGINEERING ASSOCIATES, INC.
* * * P A R T S   L I S T * * *

ISSUED	APPROVED	REV DATE	REV	ASSEMBLY NUMBER	DESCRIPTION	MODEL
05/13/80	BY *BM*	05/13/80	D	ASY-0112-03	POWER AMP	SEA 112

REF. DES.	PART NUMBER	DESCRIPTION & REMARKS	
R304	RES-0001-271	RESISTOR	270
R305	RES-0001-681	RESISTOR	680
R306	RES-0001-272	RESISTOR	2.7K
R307	RES-0002-181	RESISTOR 1/2 W	180
R308	RES-0001-047	RESISTOR	4.7
R309	RES-0005-220	RESISTOR 2W	22
R310	RES-0005-220	RESISTOR 2W	22
R311	RES-0002-271	RESISTOR 1/2W	270
R312	RES-0001-821	RESISTOR	820
R313	RES-0026-100	RESISTOR VARIABLE	10
R316	RES-0005-100	RESISTOR 2W	10
R317	RES-0001-102	RESISTOR	1K
R318	RES-0001-102	RESISTOR	1K
R320	RES-0001-151	RESISTOR	150
R321	RES-0001-271	RESISTOR	270
R322	RES-0001-151	RESISTOR	150
R323	RES-0001-100	RESISTOR	10
R324	RES-0002-271	RESISTOR 1/2W	270
R325	RES-0025-104	RESISTOR VARIABLE	100K
R326	RES-0025-102	RESISTOR VARIABLE	1K
R327	RES-0000-001	FACTORY SELECT	
T301	ASY-0101-11	TRANSFORMER, INPUT	
T302	ASY-0101-04A	TRANSFORMER, PREDRIVER	
T303	ASY-0101-08	TRANSFORMER, DRIVER	
T304	ASY-0101-07	TRANSFORMER, OUTPUT	
TR301	TER-0001-001	TERMINAL	2010B
TR302	TER-0004-001	TERMINAL	STAKE
TR303	TER-0012-001	BARRIER STRIP	
W301	HAR-0036-001	FLAT NYLON WASHER	

STEPHENS ENGINEERING ASSOCIATES, INC.
* * * P A R T S   L I S T * * *

ISSUED	APPROVED	REV DATE	REV	ASSEMBLY NUMBER	DESCRIPTION	MODEL
05/13/80	BY *(signature)*	02/26/80	A	ASY-0112-02	COUNTER	SEA 112

REF. DES.	PART NUMBER	DESCRIPTION & REMARKS	
R201	RES-0001-155	RESISTOR	1.5M
R202	RES-0001-223	RESISTOR	22K
R203	RES-0001-473	RESISTOR	47K
R204	RES-0001-122	RESISTOR	1.2K
R205	RES-0001-122	RESISTOR	1.2K
R206	RES-0001-472	RESISTOR	4.7K
R207	RES-0001-122	RESISTOR	1.2K
R208	RES-0001-472	RESISTOR	4.7K
R209	RES-0001-104	RESISTOR	100K
R210	RES-0001-223	RESISTOR	22K
R211	RES-0000-000	NOT USED	
R212	RES-0001-152	RESISTOR	1.5K
R213	RES-0001-104	RESISTOR	100K
R214	RES-0001-223	RESISTOR	22K
R215	RES-0000-000	NOT USED	
R216	RES-0001-223	RESISTOR	22K
R217	RES-0001-472	RESISTOR	4.7K
R218	RES-0001-222	RESISTOR	2.2K
R219	RES-0001-122	RESISTOR	1.2K
R220	RES-0001-153	RESISTOR	15K
R221	RES-0001-472	RESISTOR	4.7K
R222	RES-0001-471	RESISTOR	470
R223	RES-0001-222	RESISTOR	2.2K
R224	RES-0001-100	RESISTOR	10
R225	RES-0001-471	RESISTOR	470
R226	RES-0001-224	RESISTOR	220K
R227	RES-0001-222	RESISTOR	2.2K
R228	RES-0001-271	RESISTOR	270
R229	RES-0001-222	RESISTOR	2.2K
R230	RES-0001-222	RESISTOR	2.2K
R231	RES-0001-272	RESISTOR	2.7K
R232	RES-0001-222	RESISTOR	2.2K
R233	RES-0001-222	RESISTOR	2.2K
R234	RES-0001-223	RESISTOR	22K
R235	RES-0001-561	RESISTOR	560
R236	RES-0001-103	RESISTOR	10K
R237	RES-0001-103	RESISTOR	10K
R238	RES-0001-471	RESISTOR	470
R239	RES-0001-472	RESISTOR	4.7K
R240	RES-0001-472	RESISTOR	4.7K
R241	RES-0001-221	RESISTOR	220
R242	RES-0001-122	RESISTOR	1.2K
R243	RES-0001-331	RESISTOR	330
R244	RES-0001-561	RESISTOR	560
R245	RES-0001-331	RESISTOR	330
R246	RES-0001-100	RESISTOR	10
R247	RES-0001-181	RESISTOR	180
R248	RES-0001-222	RESISTOR	2.2K
R249	RES-0001-222	RESISTOR	2.2K
R250	RES-0001-122	RESISTOR	1.2K

STEPHENS ENGINEERING ASSOCIATES, INC.
* * * P A R T S   L I S T * * *

ISSUED	APPROVED	REV DATE	REV	ASSEMBLY NUMBER	DESCRIPTION	MODEL
05/13/80	BY	02/26/80	A	ASY-0112-02	COUNTER	SEA 112

REF. DES.	PART NUMBER	DESCRIPTION & REMARKS	
R251	RES-0001-122	RESISTOR	1.2K
R252	RES-0001-122	RESISTOR	1.2K
R253	RES-0001-122	RESISTOR	1.2K
R254	RES-0001-122	RESISTOR	1.2K
R255	RES-0001-122	RESISTOR	1.2K
R256	RES-0001-122	RESISTOR	1.2K
R257	RES-0001-472	RESISTOR	4.7K
R258	RES-0000-001	FACTORY SELECT	
R259	RES-0001-471	RESISTOR	470
TR201	TER-0004-001	TERMINAL	STAKE
Y201	CRY-0007-002	CRYSTAL	9.100 MHz